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ABSTRACT

This occupational competency analysis profile (OCAP), which is one a series of employer-verified competency lists that were developed through a modified DACUM (Developing a Curriculum) job analysis process involving business, industry, labor, and community agency representatives across Ohio, identifies the occupational, academic, and employability skills (competencies) needed to enter the occupation of automotive technician. The OCAP is divided into four sections. In the first section, 461 job tasks identified by the National Automotive Technicians Education Foundation and 12 supplementary Ohio-verified tasks are clustered into 11 units; each is assigned 1 of 3 priority levels. Listed in section 2 are 37 employability competencies and more than 200 related competency builders. Section 3, which is devoted to academic job profiles, explains the purpose of job profiling, presents an academic job profile for the job of automotive technician, and enumerates the skills needed to achieve each level of competence for each of the 7 Work Keys academic skills. Section 4 lists the academic competencies that a panel consisting of representatives of business, industry, labor, and community-based organizations deemed most crucial to entry into the occupation of automotive technician. (MN)

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OCAP

OCCUPATIONAL COMPETENCY ANALYSIS PROFILE

AUTOMOTIVE TECHNICIAN

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Introduction

What is an OCAP?

According to the *Action Plan for Accelerating the Modernization of Vocational Education: Ohio's Future at Work*—

> A comprehensive and verified employer competency list will be developed and kept current for each program
>
> —Imperative 3, Objective 2—

The Occupational Competency Analysis Profiles (OCAPs) are the Ohio Division of Vocational and Career Education's response to that objective.

OCAPs are employer-verified competency lists, which, in general, evolve from a modified DACUM job analysis process involving business, industry, labor, and community agency representatives from throughout Ohio. The OCAP process is directed by the Vocational Instructional Materials Laboratory (VIML) located at The Ohio State University's Center on Education and Training for Employment.

To facilitate the preparation of students for certification by the Board of the National Institute for Automotive Service Excellence (ASE), however, the task list of the National Automotive Technicians Education Foundation (NATEF) forms the bulk of this OCAP (Units 1-8). The NATEF Task List in the *ASE Certification for Automobile Training Programs* was reviewed and updated in March 1996 by a panel representing the major automobile manufacturers, automobile repair shop owners and technicians, automobile instructors, and automobile equipment and parts suppliers. The resulting NATEF units cover the eight automobile areas that may be certified: (1) brakes, (2) electrical/electronic systems, (3) engine performance, (4) suspension and steering, (5) automatic transmission and transaxle, (6) engine repair, (7) heating and air conditioning, and (8) manual drive train and axles. The first four units in that list are required for minimum certification or recertification.

Unit 9-11 contain those additional competencies identified by the panel of expert workers convened by the VIML as being important to the success of entry-level automotive technicians in Ohio.

How is the OCAP used?

Each OCAP identifies the occupational, academic, and employability skills (or competencies) needed to enter a given occupation or occupational area.

The NATEF section of this OCAP (Units 1-8) lists all the job tasks (*competencies*) important to the automotive technician area, clustered into broader *subunits* and *units*. All competencies are coded with a priority designation:

- ***Priority 1 (P-1)***

  Certified programs must include 95% of the P-1 tasks in the curriculum.

- ***Priority 2 (P-2)***

  Certified programs must include 80% of the P-2 tasks in the curriculum.

- ***Priority 3 (P-3)***

  Certified programs must include 50% of the P-3 tasks in the curriculum.

The Ohio-specific section of the Automotive Technician OCAP (Units 9-11) not only lists the *competencies* but also clusters those competencies into broader *units* and details the knowledge, skills, and attitudes (*competency builders*) needed to perform each competency. Within the competency list are two levels of items: core and advancing. *Core items* are those competencies identified by a panel of subject-matter experts as critical to entry-level employment in Ohio. *Advancing items* (marked with an asterisk) are those needed to advance in the occupation.

School districts may add as many units, competencies, and/or competency builders as desired to reflect local employment needs, trends, and specialties. Local advisory committees should be actively involved in the identification and verification of additional items. Instructors will be able to formulate their vocational courses of study using the OCAP for their occupational area and will be able to monitor competency gains via the new criterion-referenced competency testing program, which is tied to the competencies identified on the OCAP.

Teacher Review Panel

OCAPs are updated using materials located through an extensive review of the literature. The Vocational Instructional Materials Laboratory wishes to extend thanks and appreciation to the panel of teachers that reviewed this updated OCAP prior to verification to fine-tune and polish it for presentation to the subject-matter experts on the verification panel. The following teachers served on the Automotive Technician Teacher Review Panel:

Jim Anderson, *Greenville City Schools*, Greenville, Ohio

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Occupational Competency Analysis Profile:

Automotive Technician

NATEF Task List Priority Item Totals (by area)

Unit 1: Engine Repair
- P-1 = 11
- P-2 = 29
- P-3 = 21

Unit 2: Automatic Transmission and Transaxle
- P-1 = 11
- P-2 = 19
- P-3 = 13

Unit 3: Manual Drive Train and Axles
- P-1 = 5
- P-2 = 49
- P-3 = 22

Unit 4: Suspension and Steering
- P-1 = 11
- P-2 = 36
- P-3 = 15

Unit 5: Brakes
- P-1 = 15
- P-2 = 32
- P-3 = 5

Unit 6: Electrical/Electronic Systems
- P-1 = 14
- P-2 = 19
- P-3 = 14

Unit 7: Heating and Air Conditioning
- P-1 = 11
- P-2 = 19
- P-3 = 10

Unit 8: Engine Performance
- P-1 = 23
- P-2 = 37
- P-3 = 10

ASE-certified programs must include in the curriculum:

- 95% of the P-1 tasks
- 80% of the P-2 tasks
- 50% of the P-3 tasks

Ohio Task List Priority Item Totals (by area)

Unit 9: Basic Shop and Safety Practices
- P-1 = 5
- P-2 = 3
- P-3 = 0

Unit 10: Preventive Maintenance
- P-1 = 1
- P-2 = 1
- P-3 = 0

Unit 9: Nonmechanical Body Trim and Upholstery
- P-1 = 0
- P-2 = 1
- P-3 = 1

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NATEF Task List

The NATEF Task List from the *ASE Certification for Automobile Training Programs* is reprinted here with permission.

NOTE: For every competency in this NATEF list, the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage and disposal of chemicals in accordance with local, state, and federal safety and environmental regulations.

Unit 1: Engine Repair

Subunit 1.1: General Engine Diagnosis; Removal and Reinstallation (R & R)

Competencies:

1.1.1	Interpret and verify complaint; determine needed repairs.	P-1
1.1.2	Inspect engine assembly for fuel, oil, coolant, and other leaks; determine needed repairs.	P-2
1.1.3	Listen to engine noises; determine needed repairs.	P-2
1.1.4	Diagnose the cause of excessive oil consumption, unusual engine exhaust color, odor, and sound; determine needed repairs.	P-2
1.1.5	Perform engine vacuum tests; determine needed repairs.	P-1
1.1.6	Perform cylinder power balance tests; determine needed repairs.	P-1
1.1.7	Perform cylinder compression tests; determine needed repairs.	P-1
1.1.8	Perform cylinder leakage tests; determine needed repairs.	P-1
1.1.9	Remove engine (front-wheel drive); prepare for disassembly.	P-3
1.1.10	Reinstall engine (front-wheel drive).	P-3
1.1.11	Remove engine (rear-wheel drive); prepare for disassembly.	P-3
1.1.12	Reinstall engine (rear-wheel drive).	P-3

Subunit 1.2: Cylinder Head and Valve Train Diagnosis and Repair

Competencies:

1.2.1	Remove cylinder head(s); inspect cylinder head(s) for cracks; check gasket surface areas for warpage and leakage; check passage condition.	P-2
1.2.2	Install cylinder heads and gaskets; tighten according to manufacturer's specifications and procedures.	P-2
1.2.3	Inspect and test valve springs for squareness, pressure, and free height comparison; replace as needed.	P-2
1.2.4	Inspect valve spring retainers, locks, and valve grooves.	P-2

Continued

Subunit 1.2: Cylinder Head and Valve Train Diagnosis and Repair—Continued

1.2.5	Replace valve stem seals.	P-2
1.2.6	Inspect valve guides for wear; check valve guide height and stem-to-guide clearance; recondition or replace as needed.	P-2
1.2.7	Inspect valves; resurface or replace.	P-3
1.2.8	Inspect valve seats; resurface or replace.	P-3
1.2.9	Check valve face-to-seat contact and valve seat concentricity (runout); service seats and valves as needed.	P-3
1.2.10	Check valve spring assembled height and valve stem height; service valve and spring assemblies as needed.	P-3
1.2.11	Inspect pushrods, rocker arms, rocker arm pivots, and shafts for wear, bending, cracks, looseness, and blocked oil passages; repair or replace.	P-2
1.2.12	Inspect hydraulic or mechanical lifters; replace as needed.	P-2
1.2.13	Adjust valves (mechanical or hydraulic lifters).	P-1
1.2.14	Inspect and replace camshaft drives (including gear wear and backlash, sprocket and chain wear, overhead cam drive sprockets, drive belts, belt tension, and tensioners).	P-2
1.2.15	Inspect camshaft for runout; measure journals and lobes for wear.	P-3
1.2.16	Inspect and measure camshaft bearings for wear, damage, out-of-round, and alignment; determine needed repairs.	P-3
1.2.17	Verify camshaft(s) timing according to manufacturer's specifications and procedure.	P-2

Subunit 1.3: Engine Block Diagnosis and Repair

Competencies:

1.3.1	Inspect and replace pans, covers, gaskets, and seals.	P-3
1.3.2	Inspect engine block for cracks, passage condition, core and gallery plug condition, and surface warpage; determine needed repairs.	P-3
1.3.3	Inspect internal and external threads; repair as needed.	P-1
1.3.4	Remove cylinder wall ridges.	P-3
1.3.5	Inspect and measure cylinder walls for damage and wear; determine needed repairs.	P-2
1.3.6	Deglaze and clean cylinder walls.	P-2
1.3.7	Inspect and measure camshaft bearings for wear, damage, out-of-round, and alignment; determine needed repairs.	P-3
1.3.8	Inspect crankshaft for surface cracks and journal damage; check oil passage condition; measure journal wear; determine needed repairs.	P-3
1.3.9	Inspect and measure main and connecting rod bearings for damage, clearance, and end play; determine needed repairs (includes the proper selections of bearings).	P-2
1.3.10	Identify piston and bearing wear patterns that indicate connecting rod alignment and main bearing bore problems; inspect rod alignment and bearing bore condition.	P-3

Continued

Subunit 1.3: ***Engine Block Diagnosis and Repair—Continued***

1.3.11	Inspect, measure, service or replace pistons.	P-2
1.3.12	Inspect, measure, and install piston rings.	P-2
1.3.13	Inspect, repair or replace crankshaft vibration damper (harmonic balancer).	P-3
1.3.14	Inspect flywheel or flexplate and ring gear for cracks and wear; measure runout; determine needed repairs.	P-3
1.3.15	Inspect, remove, and replace crankshaft pilot bearing or bushing (as applicable).	P-2
1.3.16	Reassemble engine components using correct gaskets and sealants.	P-2
1.3.17	Inspect auxiliary (balance, intermediate, idler, counterbalance or silencer) shaft(s); inspect shaft(s) and support bearings for damage and wear; determine needed repairs; reinstall and time.	P-3
1.3.18	Prime engine lubrication system.	P-1

Subunit 1.4: Lubrication and Cooling Systems Diagnosis and Repair

Competencies:

1.4.1	Perform oil pressure tests; determine needed repairs.	P-2
1.4.2	Inspect oil pump gears or rotors, housing, pressure relief devices, and pump drive; replace as needed.	P-3
1.4.3	Perform cooling system tests (pressure, combustion leakage, and temperature); determine needed repairs.	P-1
1.4.4	Inspect, replace, and adjust drive belts and pulleys.	P-1
1.4.5	Inspect and replace engine cooling and heater system hoses.	P-2
1.4.6	Inspect, test, and replace thermostat and housing.	P-2
1.4.7	Inspect coolant; drain, flush, and refill cooling system with recommended coolant and bleed air as required.	P-2
1.4.8	Inspect, test, remove, and replace water pump.	P-2
1.4.9	Inspect and test radiator, pressure cap, and coolant recovery system; remove and replace radiator.	P-2
1.4.10	Clean, inspect, and test fan(s) (electrical or mechanical), fan clutch, fan shroud, and air dams.	P-2
1.4.11	Inspect and test electrical fan control system and circuits.	P-2
1.4.12	Inspect auxiliary oil coolers; replace as needed.	P-3
1.4.13	Inspect, test, and replace oil temperature and pressure switches and sensors.	P-2
1.4.14	Perform oil and filter change.	P-1

Unit 2: Automatic Transmission and Transaxle

Subunit 2.1: General Transmission and Transaxle Diagnosis

Competencies:

2.1.1	Interpret and verify driver's complaint; verify proper engine operation; determine needed repairs.	P-1
2.1.2	Diagnose unusual fluid usage, level, and condition problems; determine needed repairs.	P-1
2.1.3	Perform pressure tests; determine needed repairs.	P-1
2.1.4	Perform stall tests; determine needed repairs.	P-2
2.1.5	Perform lock-up converter system tests; determine needed repairs.	P-2
2.1.6	Diagnose electronic, mechanical, and vacuum control systems; determine needed repairs.	P-2
2.1.7	Diagnose noise and vibration problems; determine needed repairs.	P-3

Subunit 2.2 Transmission and Transaxle Maintenance and Adjustment

Competencies:

2.2.1	Inspect, adjust or replace manual shift valve and throttle (TV) linkages or cables and check gear select indicator (as applicable).	P-1
2.2.2	Service transmission; perform visual inspection; replace fluids and filters.	P-1

Subunit 2.3: In-Vehicle Transmission and Transaxle Repair

Competencies:

2.3.1	Inspect, adjust or replace (as applicable) vacuum modulator; inspect and repair or replace lines and hoses.	P-3
2.3.2	Inspect, repair, and replace governor assembly.	P-3
2.3.3	Inspect and replace external seals and gaskets.	P-3
2.3.4	Inspect extension housing; replace bushing and seals.	P-3
2.3.5	Inspect, leak test, flush, and replace cooler, lines, and fittings.	P-1
2.3.6	Inspect and replace speedometer drive gear (vehicle speed sensor), driven gear, and retainers.	P-3
2.3.7	Inspect, measure, clean, and replace valve body (includes surfaces and bores, springs, valves, sleeves, retainers, brackets, check-balls, screens, spacers, and gaskets); check/adjust valve body bolt torque.	P-2
2.3.8	Inspect servo bore, piston, seals, pin, spring, and retainers; repair or replace as needed.	P-3
2.3.9	Inspect accumulator bore, piston, seals, spring, and retainer; repair or replace as needed.	P-3

Continued

Subunit 2.3: ***In-Vehicle Transmission and Transaxle Repair—Continued***

2.3.10	Inspect, test, adjust, repair or replace transmission related electrical and electronic components (includes computers, solenoids, sensors, relays, switches, and harnesses).	P-2
2.3.11	Inspect, replace, and align power train mounts.	P-3
2.3.12	Inspect and replace parking pawl, shaft, spring, and retainer.	P-3

Subunit 2.4: Off-Vehicle Transmission and Transaxle Repair: Removal, Disassembly, and Reinstallation

Competencies:

2.4.1	Remove and reinstall transmission and torque converter (rear-wheel drive).	P-2
2.4.2	Remove and reinstall transaxle and torque converter assembly.	P-2
2.4.3	Disassemble, clean, and inspect transmission/transaxle.	P-1
2.4.4	Assemble transmission/transaxle.	P-1

Subunit 2.5: Off-Vehicle Transmission and Transaxle Repair: Oil Pump and Converter

Competencies:

2.5.1	Inspect converter flex plate, attaching parts, pilot and pump drive, and seal areas.	P-2
2.5.2	Measure torque converter end play and check for interference; check stator clutch.	P-2
2.5.3	Inspect, measure, and replace oil pump housings, shafts, vanes, rotors, gears, valves, seals, and bushings.	P-3
2.5.4	Check torque converter and transmission cooling system for contamination.	P-1

Subunit 2.6: Off-Vehicle Transmission and Transaxle Repair: Gear Train, Shafts, Bushings and Case

Competencies:

2.6.1	Check end play or preload; determine needed service.	P-2
2.6.2	Inspect, measure, and replace thrust washers and bearings.	P-2
2.6.3	Inspect oil delivery seal rings, ring grooves, and sealing surface areas.	P-2
2.6.4	Inspect bushings; replace as needed.	P-2
2.6.5	Inspect and measure planetary gear assembly (includes sun, ring gear, thrust washers, planetary gears, and carrier assembly); replace as needed.	P-2
2.6.6	Inspect cases, bores, passages, bushings, vents, and mating surfaces; replace as needed.	P-2
2.6.7	Inspect transaxle drive, link chains, sprockets, gears, bearings, and bushings; replace as needed.	P-2
2.6.8	Inspect, measure, repair, adjust or replace transaxle final drive components.	P-2
2.6.9	Inspect and reinstall parking pawl, shaft, spring, and retainer; replace as needed.	P-3

Subunit 2.7: Off-Vehicle Transmission and Transaxle Repair: Friction and Reaction Units

Competencies:

2.7.1	Inspect clutch drum, piston, check-balls, springs, retainers, seals, and friction and pressure plates); replace as needed.	P-2
2.7.2	Measure clutch pack clearance; adjust as needed.	P-1
2.7.3	Air test operation of clutch and servo assemblies.	P-1
2.7.4	Inspect roller and sprag clutch, races, rollers, sprags, springs, cages, and retainers; replace as needed.	P-2
2.7.5	Inspect bands and drums; replace as needed.	P-3

Unit 3: Manual Drive Train and Axles

Subunit 3.1: Clutch Diagnosis and Repair

Competencies:

3.1.1	Diagnose clutch noise, binding, slippage, pulsation, and chatter problems; determine needed repairs.	P-1
3.1.2	Inspect, adjust or replace clutch pedal linkage, cables, automatic adjuster mechanisms, brackets, bushings, pivots, and springs.	P-1
3.1.3	Inspect, adjust, repair or replace hydraulic clutch slave and master cylinders, lines, and hoses.	P-1
3.1.4	Inspect, adjust or replace release (throw-out) bearing, lever, and pivot.	P-2
3.1.5	Inspect and replace clutch pressure plate assembly and clutch disc.	P-2
3.1.6	Inspect, remove or replace crankshaft pilot bearing or bushing (as applicable).	P-2
3.1.7	Inspect, repair, and service or replace flywheel and ring gear.	P-2
3.1.8	Inspect engine block, clutch (bell) housing, and transmission case mating surfaces; determine needed repairs.	P-3
3.1.9	Measure flywheel-to-block runout and crankshaft end play; determine needed repairs.	P-3
3.1.10	Measure clutch (bell) housing bore-to-crankshaft runout and face squareness; determine needed service.	P-3

Subunit 3.2: Transmission Diagnosis and Repair

Competencies:

3.2.1	Diagnose transmission noise, hard shifting, jumping out of gear, and fluid leakage problems; determine needed repairs.	P-1
3.2.2	Inspect, adjust, and replace transmission shift linkages, brackets, bushings, cables, pivots, and levers.	P-2
3.2.3	Inspect, replace, and align power train mounts.	P-3

Continued

Subunit 3.2: ***Transmission Diagnosis and Repair—Continued***

3.2.4	Inspect and replace transmission gaskets, seals, and sealants; inspect sealing surfaces.	P-2
3.2.5	Remove and reinstall transmission.	P-2
3.2.6	Disassemble, clean, and reassemble transmission components.	P-2
3.2.7	Inspect, adjust, and reinstall transmission shift cover, forks, grommets, levers, shafts, sleeves, detent mechanisms, interlocks, and springs.	P-2
3.2.8	Inspect and reinstall input (clutch) shaft and bearings.	P-2
3.2.9	Inspect and reinstall main shaft, gears, thrust washers, bearings, and retainers.	P-2
3.2.10	Inspect and reinstall synchronizer hub, sleeve, keys (inserts), springs, and blocking rings.	P-2
3.2.11	Inspect and reinstall counter (cluster) gear, shaft, bearings, thrust washers, and retainers; check end play; adjust as needed.	P-2
3.2.12	Inspect and reinstall reverse idler gear, shaft, bearings, thrust washers, and retainers; check end play; adjust as needed.	P-2
3.2.13	Inspect and replace speedometer drive gear, driven gear, vehicle speed sensor (VSS), and retainers.	P-2
3.2.14	Inspect, repair, and replace extension housing and transmission case mating surfaces, bores, bushings, and vents.	P-3
3.2.15	Inspect lubrication devices (oil pump or slingers).	P-3

Subunit 3.3: **Transaxle Diagnosis and Repair**

Competencies:

3.3.1	Diagnose transaxle noise, hard shifting, jumping out of gear, and fluid leakage problems; determine needed repairs.	P-1
3.3.2	Inspect, adjust, and reinstall transaxle shift linkages, brackets, bushings, cables, pivots, and levers.	P-3
3.3.3	Inspect and reinstall power train mounts.	P-3
3.3.4	Remove and reinstall transaxle.	P-2
3.3.5	Inspect and replace transaxle gaskets, seals, and sealants; inspect sealing surfaces.	P-2
3.3.6	Remove and replace transaxle final drive.	P-3
3.3.7	Disassemble and clean transaxle final drive.	P-3
3.3.8	Inspect, adjust, and reinstall transaxle shift cover, forks, levers, grommets, shafts, sleeves, detent mechanism, interlocks, and springs.	P-2
3.3.9	Inspect and reinstall input (clutch) shaft and bearings.	P-2
3.3.10	Inspect and reinstall output shaft, gears, thrust washers, bearings, and retainers.	P-2
3.3.11	Measure end play or preload (shim or spacer selection procedure) on transaxle shafts; adjust as needed.	P-2
3.3.12	Inspect and reinstall synchronizer hub, sleeve, keys (inserts), springs, and blocking rings.	P-2

Continued

Subunit 3.3: ***Transaxle Diagnosis and Repair—Continued***

3.3.13	Inspect and reinstall reverse idler gear, shaft, bearings, thrust washers, and retainers.	P-2
3.3.14	Inspect transaxle case, mating surfaces, bores, bushings, and vents.	P-2
3.3.15	Inspect and reinstall speedometer drive gear, driven gear, vehicle speed sensors (VSS), and retainers.	P-2
3.3.16	Diagnose differential assembly noise and vibration problems; determine needed repairs.	P-3
3.3.17	Remove, inspect, measure, adjust, and reinstall differential pinion gears (spiders), shaft, side gears, side bearings, thrust washers, and case assembly.	P-2
3.3.18	Inspect lubrication devices (oil pump or slingers).	P-3

Subunit 3.4: Drive and Half Shaft Universal and Constant-Velocity (CV) Joint Diagnosis and Repair

Competencies:

3.4.1	Diagnose constant-velocity (CV) joint noise and vibration problems; determine needed repairs.	P-2
3.4.2	Diagnose universal joint noise and vibration problems; determine needed repairs.	P-2
3.4.3	Diagnose front wheel drive (FWD) front wheel bearing noise and vibration problems; determine needed repairs.	P-2
3.4.4	Inspect, service, and replace shafts, yokes, boots, and universal/CV joints.	P-2
3.4.5	Inspect, service, and replace shaft center support bearings.	P-3
3.4.6	Check and correct shaft balance; measure shaft runout; measure and adjust driveline angles.	P-3

Subunit 3.5: Rear Axle Diagnosis and Repair: Ring and Pinion Gears and Differential Case Assembly

Competencies:

3.5.1	Diagnose noise and vibration problems; determine needed repairs.	P-2
3.5.2	Diagnose fluid leakage problems; determine needed repairs.	P-2
3.5.3	Inspect and replace companion flange and pinion seal; measure companion flange runout.	P-2
3.5.4	Inspect ring gear and measure runout; determine needed repairs.	P-2
3.5.5	Remove and inspect drive pinion gear, spacers, sleeves, and bearings.	P-2
3.5.6	Measure and adjust drive pinion depth.	P-2
3.5.7	Measure and adjust drive pinion bearing preload.	P-2
3.5.8	Measure and adjust side bearing preload and ring and pinion gear total backlash and backlash variation on a differential carrier assembly (threaded cup and shim types).	P-2
3.5.9	Check ring and pinion tooth contact patterns; adjust as needed.	P-2
3.5.10	Disassemble, inspect, measure, and adjust or replace differential pinion gears (spiders), shaft, side gears, side bearings, thrust washers, and case.	P-2
3.5.11	Reassemble and reinstall differential case assembly; measure runout; determine needed repairs.	P-2

Subunit 3.6: Rear Axle Diagnosis and Repair: Limited Slip Differential

Competencies:

3.6.1	Diagnose noise, slippage, and chatter problems; determine needed repairs.	P-3
3.6.2	Inspect and flush differential housing; refill with correct lubricant.	P-3
3.6.3	Inspect and reinstall clutch (cone or plate) components.	P-3
3.6.4	Measure rotating torque; determine needed repairs.	P-3

Subunit 3.7: Rear Axle Diagnosis and Repair: Axle Shaft

Competencies:

3.7.1	Diagnose rear axle shafts, bearings, and seals for noise, vibration, and fluid leakage problems; determine needed repairs.	P-2
3.7.2	Inspect and replace rear axle shaft wheel studs.	P-3
3.7.3	Remove and replace rear axle shafts.	P-2
3.7.4	Inspect and replace rear axle shaft seals, bearings, and retainers.	P-2
3.7.5	Measure rear axle flange runout and shaft end play; determine needed repairs.	P-2

Subunit 3.8: Four-wheel Drive/All-wheel Drive Component Diagnosis and Repair

Competencies:

3.8.1	Diagnose noise, vibration, and unusual steering problems; determine needed repairs.	P-2
3.8.2	Inspect, adjust, and repair shifting controls (mechanical, electrical, and vacuum), bushings, mounts, levers, and brackets.	P-2
3.8.3	Remove and reinstall transfer case.	P-3
3.8.4	Disassemble, service, and reassemble transfer case and components.	P-3
3.8.5	Inspect, service, and replace front-wheel bearings and locking hubs.	P-2
3.8.6	Check drive assembly seals and vents; check lube level.	P-2
3.8.7	Inspect viscous coupling assembly.	P-3

Unit 4: Suspension and Steering

Subunit 4.1: Steering Systems Diagnosis and Repair

Competencies:

4.1.1	Disable supplemental restraint systems (SRS) in accordance with manufacturer's procedures.	P-1
4.1.2	Diagnose steering column noises, looseness, and binding problems (including tilt mechanisms); determine needed repairs.	P-3
4.1.3	Diagnose power non-rack and pinion steering gear binding, uneven turning effort, looseness, hard steering, and fluid leakage problems; determine needed repairs.	P-3

Continued

Subunit 4.1: ***Steering Systems Diagnosis and Repair—Continued***

4.1.4	Diagnose power rack and pinion steering gear vibration, looseness, and hard steering problems; determine needed repairs.	P-2
4.1.5	Inspect and replace steering shaft universal-joints(s), flexible coupling(s), collapsible column, lock cylinder mechanism, and steering wheel.	P-2
4.1.6	Adjust manual or power non-rack and pinion worm bearing preload and sector lash.	P-3
4.1.7	Remove and replace manual or power rack and pinion steering gear; inspect mounting bushings and brackets.	P-2
4.1.8	Disassemble, inspect, repair, and reassemble rack and pinion steering gear.	P-3
4.1.9	Adjust manual or power rack and pinion steering gear.	P-3
4.1.10	Inspect and replace manual or power rack and pinion steering gear inner tie rod ends (sockets) and bellows boots.	P-2
4.1.11	Inspect manual and power steering fluid levels and condition.	P-1
4.1.12	Flush, fill, and bleed power steering system.	P-2
4.1.13	Diagnose power steering fluid leakage; determine needed repairs.	P-2
4.1.14	Inspect, replace, and adjust power steering pump belt.	P-1
4.1.15	Remove, inspect, and replace power steering pump, pump mounts, pump seals, and gaskets.	P-3
4.1.16	Remove, inspect, and replace power steering pump pulley; check alignment.	P-3
4.1.17	Perform power steering system pressure test; determine needed repairs.	P-2
4.1.18	Inspect and replace power steering hoses and fittings.	P-2
4.1.19	Inspect and replace pitman arm, relay (centerlink/intermediate) rod, idler arm and mountings, and steering linkage damper.	P-3
4.1.20	Inspect, replace, and adjust tie rod ends (sockets), tie rod sleeves, and clamps.	P-2
4.1.21	Diagnose, inspect, adjust, repair or replace components of electronically-controlled steering systems.	P-3
4.1.22	Diagnose, inspect, repair or replace components of variable-assist steering systems.	P-3

Subunit 4.2: **Suspension Systems Diagnosis and Repair: Front Suspensions**

Competencies:

4.2.1	Diagnose short and long arm suspension system noises, body sway, and uneven riding height problems; determine needed repairs.	P-2
4.2.2	Diagnose MacPherson strut suspension system noises, body sway, and uneven riding height problems; determine needed repairs.	P-2
4.2.3	Remove, inspect, and replace upper and lower control arms, bushings, shafts, and rebound bumpers.	P-2
4.2.4	Remove, inspect, replace, and adjust strut (compression/tension) rods and bushings.	P-2
4.2.5	Remove, inspect, and replace upper and lower ball joints on short and long arm suspension systems.	P-2
4.2.6	Remove, inspect, and replace steering knuckle assemblies.	P-2

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Subunit 4.2: ***Suspension Systems Diagnosis and Repair: Front Suspensions—Continued***

4.2.7	Remove, inspect, and replace short and long arm suspension system coil springs and spring insulators.	P-2
4.2.8	Remove, inspect, replace, and adjust suspension system torsion bars; inspect mounts.	P-3
4.2.9	Remove, inspect, and replace stabilizer bar bushings, brackets, and links.	P-3
4.2.10	Remove, inspect, and replace ball joints on MacPherson strut suspension systems.	P-2
4.2.11	Remove, inspect, and replace MacPherson strut cartridge or assembly, strut coil spring, insulators, and upper strut bearing mount.	P-1
4.2.12	Lubricate suspension and steering systems.	P-2

Subunit 4.3: **Suspension Systems Diagnosis and Repair: Rear Suspensions**

Competencies:

4.3.1	Remove, inspect, and replace coil springs and spring insulators.	P-2
4.3.2	Remove, inspect, and replace transverse links, control arms, bushings, and mounts.	P-2
4.3.3	Remove, inspect, and replace leaf springs, leaf spring insulators (silencers), shackles, brackets, bushings, and mounts.	P-3
4.3.4	Remove, inspect, and replace MacPherson strut cartridge or assembly, strut coil spring, and insulators (silencers).	P-2

Subunit 4.4 **Suspension Systems Diagnosis and Repair: Miscellaneous Service**

Competencies:

4.4.1	Inspect, remove, and replace shock absorbers.	P-2
4.4.2	Remove, inspect, and service or replace front and rear wheel bearings.	P-1
4.4.3	Diagnose, inspect, adjust, repair or replace components of electronically-controlled suspension systems.	P-3

Subunit 4.5 **Wheel Alignment Diagnosis, Adjustment and Repair**

Competencies:

4.5.1	Diagnose vehicle wander, drift, pull, hard steering, bump steer, memory steer, torque steer, and steering return problems; determine needed repairs.	P-1
4.5.2	Measure vehicle riding height; determine needed repairs.	P-2
4.5.3	Check and adjust front and rear wheel camber; determine needed repairs.	P-2
4.5.4	Check and adjust caster; determine needed repairs.	P-2
4.5.5	Check and adjust front wheel toe; adjust as needed.	P-2
4.5.6	Center steering wheel.	P-2
4.5.7	Check toe-out-on-turns (turning radius); determine needed repairs.	P-2
4.5.8	Check SAI (steering axis inclination) and included angle; determine needed repairs.	P-2
4.5.9	Check and adjust rear wheel toe.	P-2

Continued

Subunit 4.5 ***Wheel Alignment Diagnosis, Adjustment and Repair—Continued***

4.5.10	Check rear wheel thrust angle; determine needed repairs.	P-2
4.5.11	Check for front wheel setback; determine needed repairs.	P-2
4.5.12	Check front cradle (subframe) alignment; determine needed repairs.	P-3

Subunit 4.6 **Wheel and Tire Diagnosis and Repair**

Competencies:

4.6.1	Diagnose tire wear patterns; determine needed repairs.	P-1
4.6.2	Inspect tires; check and adjust air pressure.	P-1
4.6.3	Diagnose wheel/tire vibration, shimmy, and noise problems; determine needed repairs.	P-2
4.6.4	Rotate tires according to manufacturer's recommendations.	P-1
4.6.5	Measure wheel, tire, axle, and hub runout; determine needed repairs.	P-2
4.6.6	Diagnose tire pull (lead) problem; determine corrective actions.	P-2
4.6.7	Balance wheel and tire assembly (static and dynamic).	P-1
4.6.8	Dismount, inspect, repair, and remount tire on wheel.	P-2
4.6.9	Reinstall wheel; torque lug nuts.	P-1

Unit 5: Brakes

Subunit 5.1: **Hydraulic System Diagnosis and Repair**

Competencies:

5.1.1	Measure and adjust pedal pushrod length and pedal height.	P-3
5.1.2	Check master cylinder for internal and external leaks and proper operation; determine needed repairs.	P-2
5.1.3	Remove, bench bleed, and replace master cylinder.	P-2
5.1.4	Diagnose poor stopping, pulling or dragging caused by problems in the hydraulic system; determine needed repairs.	P-1
5.1.5	Inspect brake lines and fittings for leaks, dents, kinks, rust, cracks or wear; tighten loose fittings and supports.	P-2
5.1.6	Inspect flexible brake hoses for leaks, kinks, cracks, bulging or wear; tighten loose fittings and supports.	P-2
5.1.7	Fabricate and install brake lines (double flare or ISO types); replace hoses, fittings, and supports as needed.	P-2
5.1.8	Select, handle, store, and install brake fluids to proper level.	P-1
5.1.9	Inspect, test, and replace metering (hold-off), proportioning (balance), pressure differential, and combination valves.	P-2
5.1.10	Inspect, test, replace, and adjust height (load) sensing proportioning valve.	P-3
5.1.11	Inspect, test, and replace components of brake warning light system.	P-2
5.1.12	Bleed (manual, pressure, vacuum or surge) brake system; flush hydraulic system.	P-1

Subunit 5.2: Drum Brake Diagnosis and Repair

Competencies:

5.2.1	Diagnose poor stopping, noise, pulling, grabbing, dragging or pedal pulsation problems; determine needed repairs.	P-1
5.2.2	Remove, clean (using proper safety procedures), inspect, and measure brake drums; service or replace as needed.	P-1
5.2.3	Mount brake drum on lathe; machine braking surface.	P-2
5.2.4	Remove, clean, and inspect brake shoes, springs, pins, clips, levers, adjusters/ self-adjusters, other related brake hardware, and backing support plates; lubricate and reassemble.	P-2
5.2.5	Remove and reinstall wheel cylinders.	P-2
5.2.6	Pre-adjust brake shoes and parking brake before installing brake drums or drum/hub assemblies and wheel bearings.	P-2
5.2.7	Reinstall wheel, torque lug nuts, and make final checks and adjustments.	P-1

Subunit 5.3: Disc Brake Diagnosis and Repair

Competencies:

5.3.1	Diagnose poor stopping, noise, pulling, grabbing, dragging or pedal pulsation caused problems; determine needed repairs.	P-1
5.3.2	Remove caliper assembly from mountings; clean and inspect for leaks and damage to caliper housing.	P-2
5.3.3	Clean and inspect caliper mounting and slides for wear and damage.	P-2
5.3.4	Remove, clean, and inspect pads and retaining hardware; determine needed service.	P-2
5.3.5	Disassemble and clean caliper assembly; inspect parts for wear, rust, scoring, and damage; replace seal, boot, and damaged or worn parts.	P-2
5.3.6	Reassemble, lubricate, and reinstall caliper, pads, and related hardware.	P-2
5.3.7	Clean, inspect, and measure rotor with a dial indicator and a micrometer; follow manufacturer's recommendations in determining need to machine or replace.	P-1
5.3.8	Refinish rotor according to manufacturer's recommendations.	P-2
5.3.9	Adjust calipers with integrated parking brake system.	P-3
5.3.10	Fill master cylinder with recommended fluid and seat pads; inspect caliper for leaks.	P-1
5.3.11	Reinstall wheel, torque lug nuts, and make final checks and adjustments.	P-1
5.3.12	Remove and replace rotor.	P-2

Subunit 5.4: Power Assist Units Diagnosis and Repair

Competencies:

5.4.1	Test pedal free travel with and without engine running; check power assist operation.	P-2
5.4.2	Check vacuum supply (manifold or auxiliary pump) to vacuum-type power booster.	P-2
5.4.3	Inspect the vacuum-type power booster unit for vacuum leaks; inspect the check valve for proper operation; repair or replace parts as needed.	P-2

Subunit 5.5: Miscellaneous (Wheel Bearings, Parking Brakes, Electrical, Etc.) Diagnosis and Repair

Competencies:

5.5.1	Diagnose wheel bearing noises, wheel shimmy, and vibration problems; determine needed repairs.	P-1
5.5.2	Remove, clean, inspect, repack, and reinstall wheel bearings and replace seals; reinstall hub and adjust wheel bearings.	P-1
5.5.3	Check parking brake cables and components for wear, rusting, binding, and corrosion; clean, lubricate, and replace as needed.	P-2
5.5.4	Check parking brake operation; adjust as needed.	P-1
5.5.5	Check operation of parking brake indicator light system.	P-2
5.5.6	Check operation of brake stop light system; adjust and service as needed.	P-1
5.5.7	Replace wheel bearing and race.	P-1

Subunit 5.6: Anti-lock Brake System

Competencies:

5.6.1	Inspect, test, and service anti-lock brake system (ABS) hydraulic, electrical, and mechanical components.	P-2
5.6.2	Diagnose poor stopping, wheel lock-up, abnormal pedal feel or pulsation, and noise problems caused by the anti-lock brake system (ABS); determine needed repairs.	P-2
5.6.3	Observe anti-lock brake system (ABS) warning light(s) at startup; determine if further diagnosis is needed.	P-2
5.6.4	Diagnose anti-lock brake system (ABS) electronic control(s) and components using self-diagnosis and/or recommended test equipment; determine needed repairs.	P-2
5.6.5	Depressurize high pressure components of the anti-lock brake system (ABS) following manufacturer's recommended safety procedures.	P-2
5.6.6	Fill the anti-lock brake system (ABS) master cylinder with recommended fluid following manufacturer's procedures; inspect system for leaks.	P-2
5.6.7	Bleed the anti-lock brake system's (ABS) front and rear hydraulic circuits following manufacturer's procedures.	P-2
5.6.8	Perform a fluid pressure (hydraulic boost) diagnosis on the high pressure anti-lock brake system (ABS); determine needed repairs.	P-2
5.6.9	Remove and install anti-lock brake system (ABS) electrical/electronic/hydraulic components following manufacturer's procedures and specifications.	P-3
5.6.10	Service, test, and adjust anti-lock brake system (ABS) speed sensors following manufacturer's recommended procedures.	P-2
5.6.11	Diagnose anti-lock brake system (ABS) braking problems caused by vehicle modifications (tire size, curb height, final drive ratio, etc.).	P-3

Unit 6: Electrical/Electronic Systems

Subunit 6.1: General Electrical System Diagnosis

Competencies:

6.1.1	Use wiring diagrams during diagnosis of electrical circuit problems.	P-1
6.1.2	Check electrical circuits with a test light; determine needed repairs.	P-2
6.1.3	Check voltage and voltage drop in electrical/electronic circuits using a digital multimeter (DMM); determine needed repairs.	P-1
6.1.4	Check current flow in electrical/electronic circuits and components using an ammeter; determine needed repairs.	P-1
6.1.5	Check electrical circuits using jumper wires; determine needed repairs.	P-2
6.1.6	Find shorts, grounds, opens, and resistance problems in electrical/electronic circuits; determine needed repairs.	P-1
6.1.7	Measure and diagnose the cause(s) of abnormal key-off battery drain; determine needed repairs.	P-1
6.1.8	Inspect and test fusible links, circuit breakers, and fuses; replace as needed.	P-1
6.1.9	Inspect and test switches, connectors, relays, and wires of electrical/electronic circuits; repair or replace as needed.	P-1

Subunit 6.2: Battery Diagnosis and Service

Competencies:

6.2.1	Perform battery state-of-charge test; determine needed service.	P-1
6.2.2	Perform battery capacity (load, high-rate discharge) test; determine needed service.	P-1
6.2.3	Maintain or restore electronic memory functions.	P-2
6.2.4	Inspect, clean, fill, and replace battery.	P-2
6.2.5	Perform slow/fast battery charge.	P-2
6.2.6	Inspect and clean battery cables, connectors, clamps, and hold-downs; repair or replace as needed.	P-1
6.2.7	Start a vehicle using jumper cables and a battery or auxiliary power supply.	P-1

Subunit 6.3: Starting System Diagnosis and Repair

Competencies:

6.3.1	Perform starter current draw and circuit voltage drop test; determine needed repairs.	P-1
6.3.2	Inspect and test starter relays and solenoids; replace as needed.	P-2
6.3.3	Remove and replace/reinstall starter.	P-2
6.3.4	Perform starter bench tests; determine needed repairs.	P-2
6.3.5	Inspect, test, and repair or replace switches, connectors, and wires of starter control circuits.	P-2
6.3.6	Disassemble, clean, inspect, and test starter components; replace as needed.	P-3

Subunit 6.4: Charging System Diagnosis and Repair

Competencies:

6.4.1	Diagnose charging system problems that cause an undercharge, a no-charge or an overcharge condition.	P-1
6.4.2	Inspect and adjust alternator drive belts; replace as needed.	P-1
6.4.3	Inspect and test voltage regulator; replace as needed.	P-2
6.4.4	Remove, inspect, and replace/reinstall alternator.	P-2
6.4.5	Disassemble, clean, inspect, and test alternator components; replace as needed.	P-3
6.4.6	Perform charging circuit voltage drop tests; determine needed repairs.	P-2

Subunit 6.5: Lighting Systems Diagnosis and Repair

Competencies:

6.5.1	Diagnose brighter than normal, intermittent, dim or no light operation.	P-2
6.5.2	Inspect, replace, and aim headlights and bulbs.	P-2
6.5.3	Inspect and diagnose incorrect turn signal or hazard light operation; repair or replace as needed.	P-2

Subunit 6.6: Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair

Competencies:

6.6.1	Diagnose intermittent, high, low or no gauge readings.	P-2
6.6.2	Test gauge circuit voltage regulators (limiters); replace as needed.	P-3
6.6.3	Inspect and test gauges and gauge sending units; replace as needed.	P-2
6.6.4	Inspect and test connectors, wires, and printed circuit boards of gauge circuits; repair or replace as needed.	P-3
6.6.5	Diagnose incorrect operation of warning devices and other driver information systems.	P-2
6.6.6	Diagnose intermittent, high, low or no readings on electronic instrument clusters.	P-3
6.6.7	Inspect and test sensors, sending units, connectors, and wires of electronic instrument circuits; repair or replace as needed.	P-3

Subunit 6.7: Horn and Wiper/Washer Diagnosis and Repair

Competencies:

6.7.1	Diagnose incorrect horn operation; repair as needed.	P-3
6.7.2	Diagnose incorrect wiper operation; diagnose wiper speed control and park problems; repair as needed.	P-3
6.7.3	Diagnose incorrect windshield washer operation; repair as needed.	P-3

Subunit 6.8: Accessories Diagnosis and Repair

Competencies:

6.8.1	Diagnose incorrect operation of motor-driven accessory circuits; repair as needed.	P-2
6.8.2	Diagnose incorrect heated glass operation; repair as needed.	P-3
6.8.3	Diagnose incorrect electric door and hatch/trunk lock operation; repair as needed.	P-3
6.8.4	Diagnose incorrect operation of cruise control systems; repair as needed.	P-3
6.8.5	Diagnose supplemental restraint system (SRS) problems; repair as needed. (Note: Follow manufacturer's safety procedures to prevent accidental deployment.)	P-3
6.8.6	Diagnose radio static and weak, intermittent, or no radio reception.	P-3

Unit 7: Heating and Air Conditioning

Subunit 7.1: A/C System Diagnosis and Repair

Competencies:

7.1.1	Diagnose unusual operating noises in the A/C system; determine needed repairs.	P-2
7.1.2	Conduct a performance test of the A/C system; determine needed repairs.	P-2
7.1.3	Leak test A/C system; determine needed repairs.	P-2
7.1.4	Inspect the condition of discharged oil.	P-2
7.1.5	Select oil type; measure and add oil to the A/C system as needed.	P-2

Subunit 7.2: Refrigeration System Component Diagnosis and Repair: Compressor and Clutch

Competencies:

7.2.1	Diagnose A/C system problems that cause the protection devices (pressure, thermal, and PCM) to interrupt system operation; determine needed repairs.	P-2
7.2.2	Inspect A/C compressor drive belts; replace and adjust as needed.	P-2
7.2.3	Inspect, test, and replace A/C compressor clutch components or assembly.	P-2
7.2.4	Remove and replace A/C compressor and mountings.	P-2
7.2.5	Inspect and replace A/C compressor shaft seal assembly(ies).	P-2

Subunit 7.3: Refrigeration System Component Diagnosis and Repair: Evaporator, Receiver/Drier, Condenser, Etc.

Competencies:

7.3.1	Diagnose A/C system problems caused by too much moisture in the refrigerant; determine needed repairs.	P-3
7.3.2	Install A/C system filter.	P-3
7.3.3	Remove and inspect A/C system mufflers, hoses, lines, fittings, o-rings, seals, and service valves; replace as needed.	P-2

Continued

Subunit 7.3: ***Refrigeration System Component Diagnosis and Repair: Evaporator, Receiver/Drier, Condenser, Etc.—Continued***

7.3.4	Inspect A/C condenser for air flow restrictions; service as required.	P-3
7.3.5	Inspect receiver/drier or accumulator/drier; replace as needed.	P-2
7.3.6	Inspect and test expansion valve or orifice (expansion) tube; replace as needed.	P-2
7.3.7	Inspect evaporator housing water drain; repair as needed.	P-3

Subunit 7.4: Heating and Engine Cooling Systems Diagnosis and Repair

Competencies:

7.4.1	Diagnose temperature control problems in the heater/ventilation system; determine needed repairs.	P-2
7.4.2	Perform cooling system, cap, and recovery system tests (pressure, combustion leakage, and temperature); determine needed repairs.	P-1
7.4.3	Inspect engine cooling and heater system hoses and belts; replace as needed.	P-1
7.4.4	Inspect, test, and replace thermostat and housing.	P-1
7.4.5	Determine coolant condition; drain and recover.	P-1
7.4.6	Flush system and refill with recommended coolant; bleed system.	P-1
7.4.7	Clean, inspect, and test fan, fan clutch (electrical and mechanical), fan shroud, and air dams; replace as needed.	P-2
7.4.8	Inspect and test heater control valve(s); replace as needed.	P-2

Subunit 7.5: Operating Systems and Related Controls Diagnosis and Repair: Electrical

Competencies:

7.5.1	Diagnose failures in the electrical controls of heating and A/C systems; determine needed repairs.	P-2
7.5.2	Inspect and test A/C-heater blower, motors, resistors, switches, relays, wiring, and protection devices; repair or replace as needed.	P-2
7.5.3	Test A/C compressor load cut-off systems; determine needed repairs.	P-3

Subunit 7.6: Operating Systems and Related Controls Diagnosis and Repair: Vacuum/Mechanical

Competencies:

7.6.1	Diagnose failures in the vacuum and mechanical controls of the heating and A/C system; determine needed repairs.	P-2
7.6.2	Inspect and test A/C-heater control panel assembly; replace as needed.	P-3
7.6.3	Inspect and test A/C-heater control cables and linkages; adjust or replace as needed.	P-3
7.6.4	Inspect and test A/C-heater vacuum control switches, hoses, diaphragms (motors), vacuum reservoir, check valve, and restrictors; replace as needed.	P-3
7.6.5	Inspect and test A/C-heater ducts, doors, hoses, and outlets; replace as needed.	P-3

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Subunit 7.7: Operating Systems and Related Controls Diagnosis and Repair: Automatic and Semi-Automatic Temperature Controls

Competencies:

7.7.1	Check operation of automatic and semi-automatic heating, ventilation, and air-conditioning (HVAC) control systems; determine needed repairs.	P-3

Subunit 7.8: Refrigerant Recovery, Recycling, and Handling

Competencies:

7.8.1	Verify correct operation and maintenance of refrigerant handling equipment.	P-1
7.8.2	Identify and recover A/C system refrigerant.	P-1
7.8.3	Recycle refrigerant.	P-1
7.8.4	Label and store refrigerant.	P-1
7.8.5	Test recycled refrigerant for non-condensable gases.	P-1
7.8.6	Evacuate and charge A/C system.	P-1

Unit 8: Engine Performance

Subunit 8.1: General Engine Diagnosis

Competencies:

8.1.1	Interpret and verify complaint; determine needed repairs.	P-1
8.1.2	Inspect engine assembly for fuel, oil, coolant, and other leaks; determine needed repairs.	P-2
8.1.3	Diagnose unusual engine noise or vibration problems; determine needed repairs.	P-2
8.1.4	Diagnose unusual exhaust color, odor, and sound; determine needed action.	P-2
8.1.5	Perform engine absolute (vacuum/boost) manifold pressure tests; determine needed repairs.	P-1
8.1.6	Perform cylinder power balance test; determine needed action.	P-1
8.1.7	Perform cylinder compression test; determine needed action.	P-1
8.1.8	Perform cylinder leakage test; determine needed action.	P-1
8.1.9	Diagnose engine mechanical, electrical, electronic, fuel, and ignition problems with an oscilloscope and engine diagnostic equipment; determine needed action.	P-1
8.1.10	Prepare 4 or 5 gas analyzer; inspect and prepare vehicle for test and obtain exhaust readings; interpret readings and determine needed action.	P-1

Subunit 8.2: Computerized Engine Controls Diagnosis and Repair

Competencies:

8.2.1	Diagnose emissions or driveability problems resulting from failure of computerized engine controls with no diagnostic trouble codes stored; determine needed repairs.	P-2
8.2.2	Retrieve and record stored diagnostic trouble codes.	P-1
8.2.3	Diagnose the causes of emissions or driveability problems resulting from failure of computerized engine controls with stored diagnostic trouble codes.	P-2
8.2.4	Inspect, test, adjust, and replace computerized engine control system sensors, powertrain control module (PCM), actuators, and circuits.	P-2
8.2.5	Obtain and interpret digital multimeter (DMM) readings.	P-1
8.2.6	Access and use electronic service information (ESI).	P-3
8.2.7	Locate and interpret vehicle and major component identification numbers (VIN, vehicle certification labels and calibration decals).	P-1
8.2.8	Inspect and test power and ground circuits and connections; service or replace as needed.	P-1
8.2.9	Practice recommended precautions when handling static sensitive devices.	P-2
8.2.10	Diagnose driveability and emissions problems resulting from failures of interrelated systems (cruise control, security alarms, torque controls, suspension controls, traction controls, torque management, A/C, automatic transmissions, and similar systems); determine needed repairs.	P-3

Subunit 8.3: Ignition System Diagnosis and Repair

Competencies:

8.3.1	Diagnose no-starting, driveability, and emissions problems on vehicles with electronic ignition (distributorless) systems; determine needed repairs.	P-1
8.3.2	Diagnose no-starting, driveability, and emissions problems on vehicles with distributor ignition (DI) systems; determine needed repairs.	P-1
8.3.3	Inspect and test ignition primary circuit wiring and components; repair or replace as needed.	P-2
8.3.4	Inspect and test distributor; service as needed.	P-2
8.3.5	Inspect and test ignition system secondary circuit wiring and components; replace as needed.	P-2
8.3.6	Inspect and test ignition coil(s); replace as needed.	P-2
8.3.7	Check and adjust (where applicable) ignition system timing and timing advance/retard. P-1	
8.3.8	Inspect and test ignition wiring harness and connectors; replace as needed.	P-2
8.3.9	Inspect and test ignition system pick-up sensor or triggering devices; replace as needed.	P-2
8.3.10	Inspect and test ignition control module; replace as needed.	P-2

Subunit 8.4: Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair

Competencies:

8.4.1	Diagnose hot or cold no-starting, hard starting, poor driveability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, dieseling, and emissions problems on vehicles with carburetor-type fuel systems; determine needed action.	P-3
8.4.2	Diagnose hot or cold no-starting, hard starting, poor driveability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, dieseling, and emissions problems on vehicles with injection-type fuel systems; determine needed action.	P-1
8.4.3	Inspect fuel tank and fuel cap; inspect and replace fuel lines, fittings, and hoses.	P-2
8.4.4	Check fuel for contaminants and quality.	P-2
8.4.5	Inspect and test mechanical and electrical fuel pumps and pump control systems; replace as needed.	P-2
8.4.6	Replace fuel filters.	P-1
8.4.7	Inspect and test fuel pressure regulation system and components of injection type fuel systems; adjust or replace as needed.	P-2
8.4.8	Inspect and test cold enrichment system components; adjust or replace as needed.	P-2
8.4.9	Remove, clean, and reinstall throttle body; adjust related linkages.	P-2
8.4.10	Inspect and test fuel injectors; clean and replace.	P-2
8.4.11	Inspect throttle body mounting plates, air induction and filtration system, intake manifold, and gaskets; clean or replace as needed.	P-2
8.4.12	Check/adjust idle speed and fuel mixture where applicable.	P-2
8.4.13	Remove, inspect, and test vacuum and electrical components and connections of fuel system; repair or replace as needed.	P-2
8.4.14	Inspect exhaust manifold, exhaust pipes, mufflers, resonators, tail pipes, and heat shields; repair or replace as needed.	P-2
8.4.15	Perform exhaust system back-pressure test; determine needed action.	P-2
8.4.16	Test the operation of turbocharger/supercharger systems; determine needed action.	P-3
8.4.17	Remove, clean, inspect, and repair or replace turbocharger/supercharger system components.	P-3
8.4.18	Identify the causes of turbocharger/supercharger failure; determine needed action.	P-3

Subunit 8.5: Emissions Control Systems Diagnosis and Repair: Positive Crankcase Ventilation

Competencies:

8.5.1	Diagnose oil leaks, emissions and driveability problems resulting from failure of the positive crankcase ventilation (PCV) system.	P-1
8.5.2	Inspect and test positive crankcase ventilation (PCV) filter/breather cap, valve, tubes, orifices, and hoses; service or replace as needed.	P-2

Subunit 8.6: Emissions Control Systems Diagnosis and Repair: Exhaust Gas Recirculation

Competencies:

8.6.1	Diagnose emissions and driveability problems caused by failure of the exhaust gas recirculation (EGR) system.	P-1
8.6.2	Inspect and test valve, valve manifold, and exhaust passages of exhaust gas recirculation (EGR) systems; service or replace as needed.	P-2
8.6.3	Inspect and test vacuum/pressure controls, filters, and hoses of exhaust gas recirculation (EGR) systems; service or replace as needed.	P-2
8.6.4	Inspect and test electrical/electronic sensors, controls, and wiring of exhaust gas recirculation (EGR) systems; repair or replace as needed.	P-2

Subunit 8.7: Emissions Control Systems Diagnosis and Repair: Exhaust Gas Treatment

Competencies:

8.7.1	Diagnose emissions and driveability problems resulting from failure of the secondary air injection and catalytic converter systems.	P-2
8.7.2	Inspect and test mechanical components of secondary air injection systems; service or replace as needed.	P-2
8.7.3	Inspect and test electrical/electronically-operated components and circuits of air injection systems; replace as needed.	P-2
8.7.4	Inspect and test components of catalytic converter systems; replace as needed.	P-2

Subunit 8.8: Emissions Control Systems Diagnosis and Repair: Intake Air Temperature Controls

Competencies:

8.8.1	Diagnose emissions and driveability problems resulting from failure of the intake air temperature control systems.	P-3
8.8.2	Inspect and test components of intake air temperature control systems; replace as needed.	P-3

Subunit 8.9: Emissions Control Systems Diagnosis and Repair: Early Fuel Evaporation (Intake Manifold Temperature) Controls

Competencies:

8.9.1	Diagnose emissions and driveability problems resulting from failure of early fuel evaporation control systems.	P-3
8.9.2	Inspect and test components of early fuel evaporation control systems; service or replace as needed.	P-3

Subunit 8.10: Emissions Control Systems Diagnosis and Repair: Evaporative Emissions Controls

Competencies:

8.10.1	Diagnose emissions and driveability problems resulting from failure of evaporative emissions control system.	P-2
8.10.2	Inspect and test components and hoses of evaporative emissions control system; replace as needed.	P-2

Subunit 8.11: Engine Related Service

Competencies:

8.11.1	Adjust valves on engines with mechanical or hydraulic lifters.	P-1
8.11.2	Verify correct camshaft timing; determine needed action.	P-1
8.11.3	Verify engine operating temperature; determine needed action.	P-1
8.11.4	Perform cooling system pressure tests; check coolant condition; inspect and test radiator, pressure cap, coolant recovery tank, and hoses; service or replace as needed.	P-1
8.11.5	Inspect and test thermostat, by-pass, and housing; replace as needed.	P-1
8.11.6	Inspect and test mechanical/electrical fans, fan clutch, fan shroud/ducting, air dams, and fan control devices; service or replace as needed.	P-2

Supplementary Ohio-Verified Tasks

Unit 9: Basic Shop and Safety Practices

Competency 9.1: Utilize personal safety equipment P-1

Competency Builders:

9.1.1	Wear eye and ear protection in accordance with Occupational Safety and Health Administration (OSHA) standards
9.1.2	Wear prescribed foot and hand protection
9.1.3	Wear clothing in accordance with OSHA standards
9.1.4	Remove jewelry in accordance with shop policy
9.1.5	Secure long hair
9.1.6	Practice established lifting techniques
9.1.7	Maintain personal protective equipment

Competency 9.2: Respond to fire situations P-2

Competency Builders:

9.2.1 Locate fire exits and alarms
9.2.2 Follow established evacuation procedures
9.2.3 Locate fire blankets and first-aid kits
9.2.4 Identify types of fires
9.2.5 Demonstrate use of fire extinguishers in accordance with established procedures
9.2.6 Maintain operability of fire extinguishers in accordance with established procedures
9.2.7 Follow established reporting procedures

Competency 9.3: Demonstrate general safety practices P-1

Competency Builders:

9.3.1 Interpret shop safety policies and procedures
9.3.2 Comply with shop safety plan
9.3.3 Respond to emergencies and injuries in accordance with facility requirements (e.g., apply basic first aid, cardiopulmonary resuscitation)
9.3.4 Report injuries to supervisor
9.3.5 Complete written safety and injury reports
9.3.6 Practice established procedures for jacking, lifting, moving, and blocking vehicles and shop equipment
9.3.7 Check brakes before moving vehicular equipment
9.3.8 Demonstrate safe driving practices according to shop procedures
9.3.9 Practice established safety procedures for using chains and straps
9.3.10 Maintain hand tools in safe operating condition
9.3.11 Maintain shop equipment in safe operating condition in accordance with manufacturers'/OSHA specifications
9.3.12 Comply with lock-out/tag-out procedures for defective equipment
9.3.13 Identify offenses that could result in unsafe working conditions leading to disciplinary actions (e.g., horseplay, substance abuse, theft)

Competency 9.4: Maintain safe work environment P-1

Competency Builders:

9.4.1 Maintain clean work environment
9.4.2 Follow Environmental Protection Agency (EPA) regulations for air filtering and ventilation of the work environment
9.4.3 Identify sources of contamination and other hazards
9.4.4 Contain sources of air-borne contamination and other hazards (e.g., asbestos)
9.4.5 Follow established safety procedures for the draining, removal, and storage of gasoline tanks
9.4.6 Follow safety rules for handling flammable liquids
9.4.7 Follow EPA regulations for the storage, use, recycling, and disposal of hazardous materials.

Continued

Competency 9.4: ***Maintain safe work environment****—Continued*

9.4.8 Analyze liability associated with hazardous material disposal
9.4.9 Respond to hazardous chemical spills
9.4.10 Report unsafe practices and conditions
9.4.11 Correct unsafe practices and conditions
9.4.12 Interpret OSHA Right-to-Know law
9.4.13 Interpret material safety data sheets (MSDSs)
9.4.14 Identify resources for determining employee's rights to information

Competency 9.5: Access needed information using available references and resources P-1

Competency Builders:

9.5.1 Identify available resources (e.g., manufacturers' specifications, videos, computer programs, service bulletins, service manuals, parts manuals, company procedure manuals, manufacturer's toll-free numbers, worldwide web sites, and estimating guides)
9.5.2 Identify reference materials and resources appropriate for given task
9.5.3 Locate needed information within given references and resources
9.5.4 Interpret reference materials and resources, including text, charts, graphs, schematics, illustrations, and tables

Competency 9.6: Demonstrate use of basic tools P-1

Competency Builders:

9.6.1 Perform basic math functions (e.g., addition, subtraction, multiplication, and division of whole numbers, fractions, and decimals)
9.6.2 Identify tools and their uses
9.6.3 Select tools appropriate for given task
9.6.4 Apply metric and English measurement skills
9.6.5 Measure inside/outside diameters, lift, end-play, run-out, and backlash

Competency 9.7: Provide customer service P-2

Competency Builders:

9.7.1 Prepare service orders with customer input
9.7.2 Communicate solutions to customers
9.7.3 Interpret vehicle identification number (VIN) codes
9.7.4 Complete service or work orders
9.7.5 Document services recommended and/or performed
9.7.6 Ensure readability of documentation (e.g., legible writing, accurate spelling)
9.7.7 Identify consumer rights resources

Competency 9.8: Acquire parts P-2

Competency Builders:

9.8.1 Collect necessary information (e.g., make, model, year, VIN, option codes)
9.8.2 Convey information to parts person
9.8.3 Check for price
9.8.4 Check for availability
9.8.5 Confirm that the part received is the correct one

Unit 10: Preventive Maintenance

Competency 10.1: Review vehicle maintenance schedules P-2

Competency Builders:

10.1.1 Verify mileage
10.1.2 Verify previous maintenance
10.1.3 Verify maintenance needs
10.1.4 Prepare estimates
10.1.5 Communicate to customers the need for and importance of preventive maintenance

Competency 10.2: Inspect vehicle components and systems P-1

Competency Builders:

10.2.1 Check vehicle warning lights
10.2.2 Inspect vehicle tires
10.2.3 Examine hoses and belts
10.2.4 Inspect exhaust system
10.2.5 Examine filters (e.g., fuel, air, oil)
10.2.6 Inspect brake system
10.2.7 Inspect steering linkages
10.2.8 Inspect coolant system
10.2.9 Inspect fluid condition and levels
10.2.10 Check for the presence of leaks
10.2.11 Examine exterior lights
10.2.12 Examine seat belts
10.2.13 Inspect wipers and washers
10.2.14 Inspect exterior and interior condition of vehicle (e.g., checking for body damage; wheel cover condition; and integrity of glass, hinges, locks, and handles)

Unit 11: Nonmechanical Body Trim and Upholstery*

Competency 11.1: Replace hard and soft body trims* P-2

Competency Builders:

11.1.1 Follow procedure specified in shop manual*
11.1.2 Remove interior and exterior moldings*
11.1.3 Install interior and exterior moldings*
11.1.4 Remove interior soft trim*
11.1.5 Install interior soft trim*

Competency 11.2: Diagnose body leaks and repairs* P-3

Competency Builders:

11.2.1 Follow procedure specified in shop manual*
11.2.2 Locate leaks*
11.2.3 Diagnose leaks*
11.2.4 Repair leaks*

Notes:

Occupational Competency Analysis Profile:

Employability

Unit 1: Career Development

Competency 1.1: Investigate career options

Competency Builders:

1.1.1 Determine interests and aptitudes
1.1.2 Identify career options
1.1.3 Research interests, knowledge, abilities, and skills needed in an occupation
1.1.4 Select careers that best match interests and aptitudes
1.1.5 Identify advantages and disadvantages of career options, including self-employment and nontraditional careers

Competency 1.2: Utilize career information

Competency Builders:

1.2.1 Identify a range of career information resources
1.2.2 Use a range of resources to obtain career information (e.g., handbooks, career materials, labor market information, and computerized career-information delivery systems)
1.2.3 Demonstrate knowledge of various classification systems that categorize occupations and industries (e.g., *Dictionary of Occupational Titles*)
1.2.4 Describe the educational requirements of various occupations
1.2.5 Identify individuals in selected occupations as possible information resources, role models, or mentors
1.2.6 Describe the impact of factors such as population, climate, employment trends, and geographic location on occupational opportunities
1.2.7 Assess differences in the wages, benefits, annual incomes, cost of living, and job opportunties associated with selected career options
1.2.8 Determine labor market projections for selected career options

Competency 1.3: Participate in a career exploration activity

Competency Builders:

1.3.1 Identify career exploration activities (e.g., job shadowing, mentoring, volunteer experiences, part-time employment, and cooperative education)
1.3.2 Compare traits, skills, and characteristics required for specific career choices with individual's traits, skills, and characteristics
1.3.3 Recognize potential conflicts between personal characteristics and career choice areas
1.3.4 Describe the impact of exploration activities on current career choices

Competency 1.4: Assess the relationship between educational achievement and career planning

Competency Builders:

1.4.1 Describe how skills developed in academic and vocational programs relate to career goals
1.4.2 Describe how education relates to the selection of a college major, further training, and/or entry into the job market
1.4.3 Identify skills that can apply to a variety of occupational requirements
1.4.4 Explain the importance of possessing learning skills in the workplace

Competency 1.5: Develop an individual career plan

Competency Builders:

1.5.1 Identify career goal(s)
1.5.2 Identify worker conditions, education, training, and employment opportunities related to selected career goal(s)
1.5.3 Describe school and community resources available to help achieve career goal(s)
1.5.4 Identify career ladders possible within selected career goal(s)*
1.5.5 Identify additional experiences needed to move up identified career ladders*
1.5.6 Recognize that changes may require retraining and upgrading of employees' skills

Competency 1.6: Annually review/revise the individual career plan

Competency Builders:

1.6.1 Identify experiences that have reinforced selection of the specific career goal(s) listed on the individual career plan
1.6.2 Identify experiences that have changed the specific career goal(s) listed on the individual career plan
1.6.3 Modify the career goals(s) and educational plans on the individual career plan
1.6.4 Ensure that parents or guardians provide input into the individual career plan process
1.6.5 Identify the correlation between the individual career plan and the actual courses to be taken in high school
1.6.6 Identify the correlation between the individual career plan and postsecondary training, adult education, or employment

Unit 2: Decision Making and Problem Solving

Competency 2.1: Apply decision-making techniques in the workplace

Competency Builders:

2.1.1 Identify the decision to be made
2.1.2 Compare alternatives
2.1.3 Determine the consequences of each alternative
2.1.4 Make decisions based on values and goals
2.1.5 Evaluate the decision made

Competency 2.2: Apply problem-solving techniques in the workplace

Competency Builders:

2.2.1 Diagnose the problem, its urgency, and its causes
2.2.2 Identify alternatives and their consequences in relation to the problem
2.2.3 Recognize multicultural and nonsexist dimensions of problem solving
2.2.4 Explore possible solutions to the problem using a variety of resources
2.2.5 Compare/contrast the advantages and disadvantages of each solution
2.2.6 Determine appropriate action
2.2.7 Implement action
2.2.8 Evaluate results of action implemented

Unit 3: Work Ethic

Competency 3.1: Evaluate the relationship of self-esteem to work ethic

Competency Builders:

3.1.1 Identify special characteristics and abilities in self and others
3.1.2 Identify internal and external factors that affect self-esteem
3.1.3 Identify how individual characteristics relate to achieving personal, social, educational, and career goals
3.1.4 Identify the relationship between personal behavior and self-concept

Competency 3.2: Analyze the relationship of personal values and goals to work ethic both in and out of the workplace

Competency Builders:

3.2.1 Distinguish between values and goals
3.2.2 Determine the importance of values and goals
3.2.3 Evaluate how one's values affect one's goals
3.2.4 Identify own short- and long-term goals
3.2.5 Prioritize own short- and long-term goals
3.2.6 Identify how one's values are reflected in one's work ethic
3.2.7 Identify how interactions in the workplace affect one's work ethic
3.2.8 Identify how life changes affect one's work ethic

Competency 3.3: Demonstrate work ethic

Competency Builders:

3.3.1 Examine factors that influence work ethic
3.3.2 Display initiative
3.3.3 Demonstrate dependable attendance and punctuality
3.3.4 Demonstrate organizational skills
3.3.5 Adhere to schedules and deadlines
3.3.6 Demonstrate a willingness to learn
3.3.7 Demonstrate a willingness to accept feedback and evaluation
3.3.8 Demonstrate interpersonal skills required for working with and for others
3.3.9 Describe appropriate employer-employee interactions for various situations
3.3.10 Express feelings and ideas in an appropriate manner for the workplace

Competency 3.4: Demonstrate safety skills

Competency Builders:

3.4.1 Practice safe work habits
3.4.2 Identify safety hazards
3.4.3 Employ preventative safety measures
3.4.4 Demonstrate appropriate care and use of equipment and facilities to ensure safety
3.4.5 Comply with safety and emergency procedures

Unit 4: Job-Seeking Skills

Competency 4.1: Prepare for employment

Competency Builders:

4.1.1 Identify traditional and nontraditional employment sources
4.1.2 Utilize employment sources
4.1.3 Research job opportunities, including nontraditional careers
4.1.4 Interpret equal employment opportunity laws
4.1.5 Explain the critical importance of personal appearance, hygiene, and demeanor throughout the employment process
4.1.6 Prepare for generic employment tests and those specific to an occupation/organization

Competency 4.2: Develop a résumé

Competency Builders:

4.2.1 Identify personal strengths and weaknesses
4.2.2 List skills and/or abilities, career objective(s), accomplishments/achievements, educational background, work experience, volunteer/community contributions, and organizational memberships
4.2.3 Select an acceptable résumé format
4.2.4 Use correct grammar and spelling and concise wording
4.2.5 Secure references
4.2.6 Complete the résumé

Competency 4.3: Complete the job application process

Competency Builders:

4.3.1 Explain the importance of an application form
4.3.2 Obtain job application forms
4.3.3 Demonstrate appropriate behaviors (e.g., personal appearance, hygiene, and demeanor) for obtaining job application forms in person
4.3.4 Describe methods for handling illegal questions on job application forms
4.3.5 Demonstrate legible written communication skills using correct grammar and spelling and concise wording
4.3.6 Return application to appropriate person
4.3.7 Request interview
4.3.8 Follow up on application status

Competency 4.4: Demonstrate interviewing skills

Competency Builders:

4.4.1 Investigate interview procedures
4.4.2 Demonstrate appropriate behaviors (e.g. appearance, hygiene, and demeanor) for the interview
4.4.3 Demonstrate question-and-answer techniques
4.4.4 Demonstrate methods for handling difficult and/or illegal interview questions
4.4.5 Use correct grammar and concise wording

Competency 4.5: Secure employment

Competency Builders:

4.5.1 Identify present and future employment opportunities within an occupation/organization
4.5.2 Research the organization/company
4.5.3 Use follow-up techniques to enhance employment potential
4.5.4 Evaluate job offer(s)
4.5.5 Respond to job offer(s)

Unit 5: Job Retention and Career Advancement Skills

Competency 5.1: Analyze the organizational structure of the workplace

Competency Builders:

5.1.1 Identify employer expectations regarding job performance, work habits, attitudes, personal appearance, and hygiene
5.1.2 Comply with company policies and procedures
5.1.3 Examine the role/relationship between employee and employer
5.1.4 Recognize opportunities for advancement and reasons for termination
5.1.5 Recognize the organization's ethics.

Competency 5.2: Maintain positive relations with others

Competency Builders:

5.2.1 Exhibit appropriate work habits and attitudes
5.2.2 Identify behaviors for establishing successful working relationships
5.2.3 Cooperate through teamwork and group participation
5.2.4 Demonstrate a willingness to compromise
5.2.5 Identify methods for dealing with harassment, bias, and discrimination based on race, color, national origin, gender, religion, disability, or age
5.2.6 Cooperate with authority
5.2.7 Accept supervision

Competency 5.3: Demonstrate accepted social and work behaviors

Competency Builders

5.3.1 Demonstrate a positive attitude
5.3.2 Demonstrate accepted conversation skills
5.3.3 Use good manners
5.3.4 Accept responsibility for assigned tasks
5.3.5 Demonstrate personal hygiene
5.3.6 Demonstrate knowledge of a position
5.3.7 Perform quality work

Competency 5.4: Analyze opportunities for personal and career growth*

Competency Builders:

5.4.1 Determine opportunities within chosen occupation/organization*
5.4.2 Determine other career opportunities outside chosen occupation/ organization*
5.4.3 Evaluate the factors involved in considering a new position within or outside an occupation/ organization*
5.4.4 Exhibit characteristics needed for advancement*

Unit 6: Technology in the Workplace

Competency 6.1: Demonstrate knowledge of technology issues

Competency Builders:

6.1.1 Demonstrate knowledge of the characteristics of technology
6.1.2 Demonstrate knowledge of how technology systems are applied
6.1.3 Assess the impact of technology on the individual, society, and environment
6.1.4 Demonstrate knowledge of the evolution of technology
6.1.5 Identify how people, information, tools and machines, energy, capital, physical space, and time influence the selection and use of technology
6.1.6 Identify legal and ethical issues related to technology (e.g., confidentiality, information sharing, copyright protection)

Competency 6.2: Demonstrate skills related to technology issues

Competency Builders:

6.2.1 Exhibit willingness to adapt to technological change
6.2.2 Utilize technological systems
6.2.3 Utilize a variety of resources and processes to solve technological problems
6.2.4 Employ higher-order thinking skills for solving technological problems
6.2.5 Work as a team member in solving technological problems
6.2.6 Use technology in a safe and responsible manner
6.2.7 Apply science, mathematics, communication, and social studies concepts to solve technological problems
6.2.8 Demonstrate ingenuity and creativity in the use of technology*
6.2.9 Utilize a formal method (systems approach) in solving technological problems*

Unit 7: Lifelong Learning

Competency 7.1: Apply lifelong learning practices to individual situations

Competency Builders:

7.1.1 Define lifelong learning
7.1.2 Identify factors that cause the need for lifelong learning
7.1.3 Identify changes that may require the retraining and upgrading of employee's skills
7.1.4 Identify avenues for lifelong learning
7.1.5 Participate in lifelong learning activities

Competency 7.2: Adapt to change

Competency Builders:

7.2.1 Analyze the causes and effects of change
7.2.2 Identify the effect of change on goals
7.2.3 Identify the importance of flexibility when reevaluating goals
7.2.4 Evaluate the need for lifelong learning experiences in adapting to change

Unit 8: Economic Education

Competency 8.1: Analyze how an economy functions as a whole

Competency Builders:

8.1.1 Describe how individuals and societies make choices to satisfy needs and wants with limited resources
8.1.2 Identify how production factors (land, labor, capital, and entrepreneurship) are used to produce goods and services
8.1.3 Illustrate how individuals and households exchange their resources for the income they use to buy goods and services
8.1.4 Explain how individuals and business firms use resources to produce goods and services to generate income
8.1.5 Identify characteristics of command, market, and traditional economies*
8.1.6 Describe how all levels of government assess taxes in order to provide services

Competency 8.2: Analyze how an economic system is a framework within which decisions are made by individuals and groups

Competency Builders:

8.2.1 List several individuals and groups that make economic decisions at the local, state, and national levels
8.2.2 Identify the important roles that local, state, and national governments play in a market economy

Continued

Competency 8.2: ***Analyze how an economic system is a framework within which decisions are made by individuals and groups—Continued***

8.2.3 List examples of how government decisions affect individuals
8.2.4 Identify how geographic locations affect the political and economic systems of the world
8.2.5 Evaluate how markets allocate goods and services
8.2.6 Explain how resources, goods, and services are exchanged in markets
8.2.7 Explain competition and its effect on the market

Competency 8.3: **Analyze the importance of making informed personal financial decisions**

Competency Builders:

8.3.1 Describe the need for personal management records
8.3.2 Create a personal budget
8.3.3 Create a budget for a family of four for one month
8.3.4 Explain how credit affects personal/family finances
8.3.5 Identify steps to avoid credit problems
8.3.6 Make informed consumer choices in response to personal needs and wants
8.3.7 Identify factors that influence consumer decisions (e.g., advertisements, peer groups, price, and location)
8.3.8 Explain the costs and benefits for individuals of various types of taxation at the local, state, and federal levels

Unit 9: Balancing Work and Family

Competency 9.1: **Analyze the effects of family on work**

Competency Builders:

9.1.1 Recognize how family values, goals, and priorities are reflected in the workplace
9.1.2 Identify present and future family structures and responsibilities
9.1.3 Describe personal and family roles
9.1.4 Analyze concerns of working parent(s)
9.1.5 Examine how family responsibilities can conflict with work
9.1.6 Identify ways to resolve family-related conflicts
9.1.7 Explain how to use support systems/community resources to help resolve family-related conflicts

Competency 9.2: **Analyze the effects of work on family**

Competency Builders:

9.2.1 Identify responsibilities associated with paid and nonpaid work
9.2.2 Compare the advantages and disadvantages of multiple incomes
9.2.3 Explain how work can conflict with family responsibilities
9.2.4 Explain how work-related stress can affect families
9.2.5 Identify family support systems and resources

Unit 10: Citizenship in the Workplace

Competency 10.1: Exercise the rights and responsibilities of citizenship in the workplace

Competency Builders:

10.1.1 Identify the basic rights and responsibilities of citizenship in the workplace
10.1.2 Identify situations in which compromise is necessary
10.1.3 Examine how individuals from various backgrounds contribute to the workplace
10.1.4 Demonstrate initiative to facilitate cooperation
10.1.5 Give/receive constructive criticism to enhance cooperation

Competency 10.2: Prepare to work in a multicultural society

Competency Builders:

10.2.1 Identify ways to live in a multicultural society with mutual respect and appreciation for others
10.2.2 Examine how culture and experience create differences in people
10.2.3 Demonstrate respect for the contributions made by all people
10.2.4 Investigate personal cultural background as a means of developing self-respect
10.2.5 Make personal choices that reduce discrimination, isolation, and prejudice
10.2.6 Work effectively with people irrespective of their race, gender, religion, ethnicity, disability, age, or cultural background

Unit 11: Leadership

Competency 11.1: Evaluate leadership styles appropriate for the workplace

Competency Builders:

11.1.1 Identify characteristics of effective leaders
11.1.2 Compare leadership styles
11.1.3 Demonstrate effective delegation skills
11.1.4 Investigate empowerment concepts
11.1.5 Identify opportunities to lead in the workplace

Competency 11.2: Demonstrate effective teamwork skills

Competency Builders:

11.2.1 Identify the characteristics of a valuable team member
11.2.2 Identify methods of involving each team member
11.2.3 Contribute to team efficiency and success
11.2.4 Determine ways to motivate team members

Competency 11.3: Utilize effective communication skills

Competency Builders:

11.3.1 Identify the importance of listening
11.3.2 Demonstrate effective listening skills
11.3.3 Demonstrate assertive communication techniques
11.3.4 Recognize the importance of verbal and nonverbal cues and messages
11.3.5 Prepare written material
11.3.6 Analyze written material
11.3.7 Give/receive feedback
11.3.8 Communicate thoughts
11.3.9 Use appropriate language
11.3.10 Follow oral and written instructions
11.3.11 Demonstrate effective telephone techniques
11.3.12 Identify technology in communications

Unit 12: Entrepreneurship

Competency 12.1: Evaluate the role of small business

Competency Builders:

12.1.1 Identify the impact of small business on the local economy
12.1.2 Examine the relationship of small business to a national (USA) and global economy
12.1.3 Identify factors that contribute to the success of small business
12.1.4 Identify factors that contribute to the failure of small business
12.1.5 Identify the components of a business plan

Competency 12.2: Examine entrepreneurship as a personal career option

Competency Builders:

12.2.1 Evaluate personal interests and skills
12.2.2 Compare personal interests and skills with those necessary for entrepreneurship
12.2.3 Determine motives for becoming an entrepreneur
12.2.4 Identify the advantages and disadvantages of owning a small business
12.2.5 Compare business ownership to working for others

Notes

Academic Job Profile

The Purpose of Job Profiling

Developed by American College Testing (ACT), the purpose of the Job Profiling process is to identify the **level** of applied academic skills that, according to business and industry, students must master to qualify for and be successful in their occupation of choice. The results of Job Profile "leveling" can help teachers to better target instruction toward their students' needs.

As part of the Ohio Vocational Competency Assessment (OVCA) program, the Vocational Instructional Materials Laboratory (VIML) at The Ohio State University has conducted Job Profiling workshops in which representatives of business, industry, labor, and community organizations identified the academic skill levels needed by entry-level workers in the occupational areas covered by the OCAPs. The Job Profiling, which was carried out in fall 1994 and spring 1995, was sponsored by the Ohio Department of Education, Division of Vocational and Adult Education.

OVCA—What Is It?

The Ohio Vocational Competency Assessment (or OVCA) package consists of two assessment components: OCAP and Work Keys. Together they measure entry-level occupational, academic, and employability skills. All OVCA items are criterion-referenced, use a multiple-choice format, and are administered using a traditional paper-and-pencil method. The OVCA is designed to do the following:

- Provide one dimension of a multi-assessment strategy for career passport credentialing
- Evaluate learner readiness for jobs requiring specific occupational, academic, and employability skills
- Assist educators in curriculum development
- Provide state-aggregated learning gain scores to comply with regulations in the Carl D. Perkins Vocational and Applied Technology Act of 1992

OCAP. The OCAP component of OVCA assesses students in occupational skills—employment requirements—in a particular occupational area. Assessment is based on the core competencies identified through the OCAP process, and each multiple-choice assessment item is correlated to those essential competencies.

Work Keys. The Work Keys component, developed by ACT, measures students' applied academic skills. All OVCA packages contain two Work Keys assessments:

- *Applied Mathematics* measures students' ability to analyze, set up, and solve math problems typically found in the workplace.
- *Locating Information* measures students' ability to use graphic documents to insert, extract, and apply information.

In addition, certain taxonomies will use the following Work Keys assessments:

- *Reading for Information* will be used by Business, Marketing, Home Economics, Health Education, and Cosmetology taxonomies.
- *Applied Technology* will be used by Trade and Industrial and Agricultural Education taxonomies.

Other optional Work Keys assessments, not included in the basic OVCA package, are *Teamwork*, *Listening*, and *Writing*.

Each Work Keys assessment is further broken down into four to five levels of achievement, with higher numbers indicating higher achievement in the assessed skill (descriptions of the levels for each Work Keys assessment are provided on pp. 49-55). For each academic skill, the Job Profiling process identifies the level required for successful entry into an occupational area.

Job Profiling—How It Works

VIML's Job Profiling process was initiated by mailing surveys to current workers in OCAP occupations all across Ohio. The survey's purpose: to have actual workers in specific occupations rate job tasks according to each task's frequency and criticality—that is, the amount of time spent performing each task relative to other tasks and the importance of each task to overall job performance.

To compiete the survey, participants examined OCAP competencies for their occupation. Based on the survey's results, VIML staff produced a list of the most critical competencies in each occupation.

The next stage of Job Profiling was to convene committees of subject-matter experts to perform "leveling," which involved the following tasks:

- Examining the frequency and criticality competency lists for an occupation
- Reviewing the levels associated with each of the seven Work Keys academic skills: *Locating Information, Reading for Information, Applied Mathematics, Applied Technology, Listening, Writing,* and *Teamwork*
- Identifying the level of skill students must master relative to each Work Keys academic skill in order to successfully perform the occupational competencies

Finally, in 1995, the initial leveling of Work Keys academic skills for the occupational area covered by this OCAP was revalidated by the new employer panel convened to update the OCAP (see inside back cover).

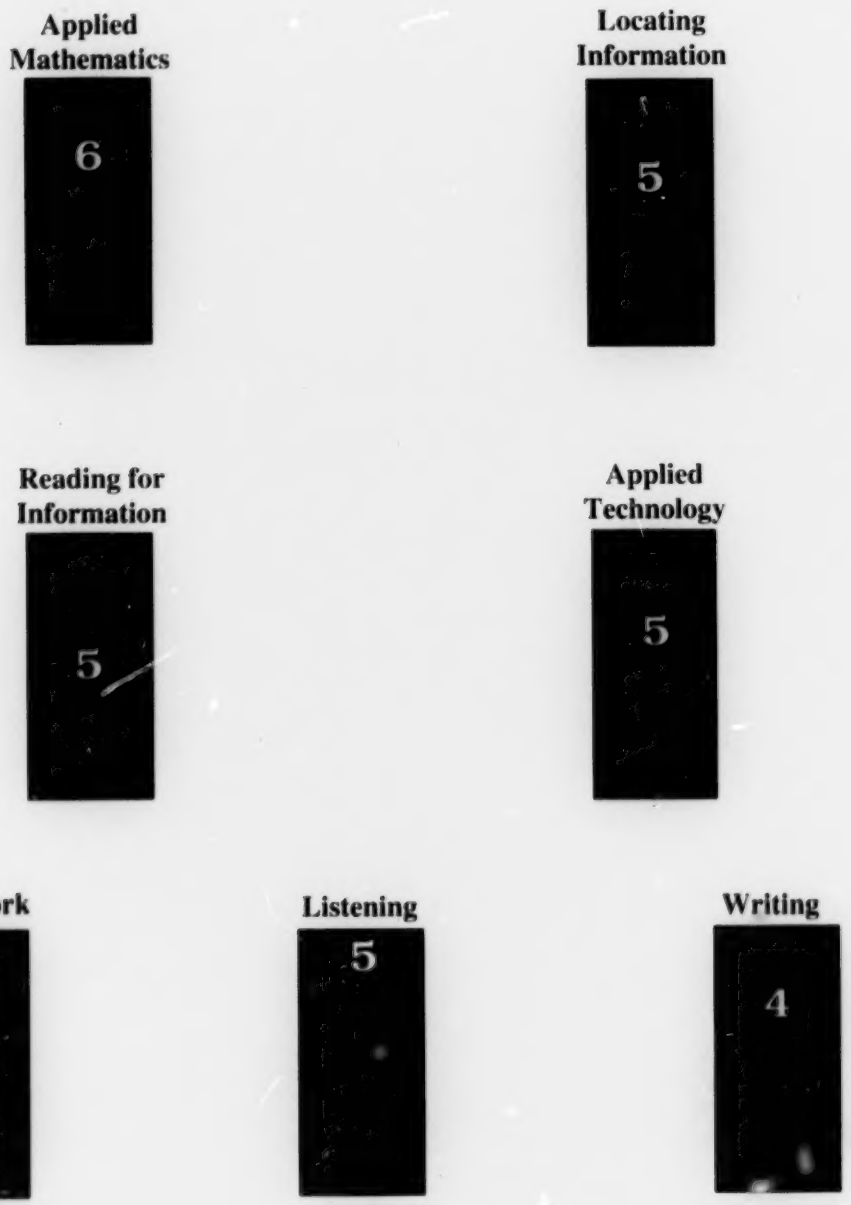
Example of Job Profiling

For every occupational area, there are shaded graphs to represent each of the seven Work Keys academic skills. Each graph shows the range of levels for that particular skill; the shading represents the academic skill level required by an entry-level worker in that occupation, as determined by the Job Profiling committee. For example:

Applied Mathematics

In the example shown, Applied Mathematics has a skill range of 3–7. The required skill level, determined by Job Profiling and shown by the highlighting, is 6.

Academic Job Profile: Automotive Technician



NOTE: Definitions of each level in each of the seven academic skill areas are provided on the pages that follow.

Levels of Work Keys Defined

The skills needed to achieve each level for each of the seven Work Keys* academic skills are as follows.

Applied Mathematics

Applied Mathematics measures skill in applying mathematical reasoning to work-related problems. There are five levels of complexity, 3 through 7, with Level 3 being the least complex and Level 7 the most complex. The levels build on each other, each incorporating the skills at the preceding levels.

Level 3

- Perform basic mathematical operations (addition, subtraction, multiplication, and division) and conversions from one form to another, using whole numbers, fractions, decimals, or percentages.
- Translate simple verbal problems into mathematical equations.
- Directly apply logical information provided to solve problems, including those with measurements and dollars and cents.

Level 4

- Perform one or two mathematical operations (such as addition, subtraction, or multiplication) on several positive or negative numbers. (Division of negative numbers is not covered until Level 5.)
- Add commonly known fractions, decimals, or percentages (e.g., ½, .75, 25%) or add three fractions that share a common denominator.
- Calculate averages, simple ratios, proportions, and rates, using whole numbers and decimals.
- Reorder verbal information before performing calculations.
- Read simple charts or graphs to obtain information needed to solve a problem.

Level 5

- Look up and calculate single-step conversions within English or non-English measurement systems (e.g., converting ounces to pounds or centimeters to meters) or between measurement systems (e.g., converting centimeters to inches).
- Make calculations using mixed units (e.g., hours and minutes).
- Determine what information, calculations, and unit conversions are needed to find a solution.

Level 6

- Calculate using negative numbers, fractions, ratios, percentages, mixed numbers, and formulas.
- Identify and correct errors in calculations.
- Translate complex verbal problems into mathematical expressions, using considerable setup and multiple-step calculations or conversions.

Level 7

- Solve problems requiring multiple steps of logic and calculation.
- Solve problems involving more than one unknown, nonlinear functions (e.g., rate of change), and applications of basic statistical concepts (e.g., error of measurement).
- Locate errors in multiple-step calculations.
- Solve problems with unusual content or format, or with incomplete or implicit information.

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Locating Information

Locating Information measures skill in using information taken from workplace graphics such as diagrams, blueprints, floor plans, tables, forms, graphs, charts, and instrument gauges. There are four levels of complexity, 3 through 6, with Level 3 being the least complex and Level 6 the most complex. The levels build on each other, each incorporating the skills at the preceding levels.

Level 3

- Find one or two pieces of information in elementary workplace graphics, such as simple order forms, bar graphs, tables, flowcharts, and floor plans.
- Fill in one or two pieces of information that are missing from elementary workplace graphics.

Level 4

- Find several pieces of information in straightforward workplace graphics, such as basic order forms, line graphs, tables, instrument gauges, maps, flowcharts, and diagrams.
- Summarize and/or compare information and trends in a single straightforward graphic.
- Summarize and/or compare information and trends among more than one straightforward workplace graphic, such as a bar chart and a data table showing related information.

Level 5

- Summarize and/or compare information and trends in single complicated workplace graphics, such as detailed forms, tables, graphs, maps, instrument gauges, and diagrams.
- Summarize and/or compare information and trends among more than one complicated workplace graphic, such as a bar chart and a data table showing related information.

Level 6

- Make decisions, draw conclusions, and/or apply information to new situations using several related and complex workplace graphics that contain a great amount of information or have challenging presentations (e.g., very detailed graphs, charts, tables, forms, maps, blueprints, diagrams).

Reading for Information

Reading for Information measures skill in reading and understanding work-related reading materials. There are five levels of complexity, 3 through 7, with Level 3 being the least complex and Level 7 the most complex. Although Level 3 is the least complex, it still represents a level of reading skill well above "no skill at all." The levels build on each other, each incorporating the skills at the preceding levels.

Level 3

- Identify uncomplicated key concepts and simple details.
- Recognize the proper placement of a step in a sequence of events, or the proper time to perform a task.
- Identify the meaning of words that are defined within a passage.
- Identify the meaning of simple words that are not defined within a passage.
- Recognize the application of instructions from a passage to situations that are described in the passage.

Level 4

- Identify details that are more subtle than those in Level 3.
- Recognize the application of more complex instructions, some of which involve several steps, to described situations.
- Recognize cause-effect relationships.

Level 5

- Identify the paraphrased definition of jargon or technical terms that are defined in a passage and recognize the application of jargon or technical terms to stated situations.
- Recognize the definition of acronyms that are defined in a passage.
- Identify the appropriate definition of words with multiple meanings.
- Recognize the application of instructions from a passage to new situations that are similar to the situations described in the reading materials.
- Recognize the applications of more complex instructions to described situations, including conditionals and procedures with multiple steps.

Level 6

- Recognize the application of jargon or technical terms to new situations.
- Recognize the application of complex instructions to new situations.
- Recognize the less-common meaning of a word with multiple meanings from context.
- Generalize from a passage to situations not described in the passage.
- Identify implied details.
- Explain the rationale behind a procedure, policy, or communication.
- Generalize from a passage to a somewhat similar situation.

Level 7

- Recognize the definitions of difficult, uncommon jargon or technical terms from context.
- Generalize from a passage to situations neither described in nor completely similar to those in a passage.

Applied Technology

Applied Technology measures skill in solving problems of a technological nature, involving the basic principles of mechanics, electricity, fluid dynamics, and thermodynamics as they apply to machines and equipment found in the workplace. There are four levels of complexity, 3 through 6, with Level 3 being the least complex and Level 6 the most complex. Although Level 3 is the least complex, it still represents a level of applied technology skill well above "no skill at all." The levels build on each other, each incorporating the skills at the preceding levels.

Level 3

- Apply the elementary physical principles underlying the operation of uncomplicated systems or tools.
- Recognize and identify relevant aspects of simple problems that involve one uncomplicated system or tool.
- Select appropriate methods or materials needed to solve problems.

Level 4

- Recognize, identify, and order relevant aspects of one moderately complex system or more than one uncomplicated system.
- Evaluate alternative solutions to determine the most appropriate one for the situation presented.

Level 5

- Solve problems based on one complex system, or one or more uncomplicated tools or systems.
- Understand and apply moderately difficult principles of mechanics, electricity, thermodynamics, and fluid dynamics, in addition to understanding complex machines and systems.
- Recognize, identify, and order relevant aspects of a problem before reaching an appropriate solution.

Level 6

- Solve problems that do not contain all the information needed to solve them, and/or in which the information provided may be out of logical order.
- Solve problems that contain extraneous information.
- Solve problems involving one or more tools or systems having a wide range of complexity.
- Apply difficult physical principles.
- Understand and correctly interpret the interaction of several complex systems.

Listening

Listening measures skill in listening to and understanding work-related messages; receiving information from customers, coworkers, or suppliers; and then writing down the information to communicate it to someone else. Students demonstrate their ability to distinguish and communicate critical information and noncritical information. **Critical information** consists of those details that the recipient of the message must have in order to understand the message and act upon it (e.g., names, phone numbers, addresses, times). **Noncritical information** can improve a message by providing details that further explain the message or its tone, but the absence of this noncritical information does not interfere with the recipient's ability to understand and accurately act upon the message. Each *Listening* level describes the **content and quality** of messages students write to describe an audio message.

Level 0

- No meaningful information, or totally inaccurate information.

Level 1

- Minimal pertinent information; enough context to provide clues as to gist of situation or source of further information.

Level 2

- Some pertinent information; may have incorrect critical information, but sketch of the situation is correct.

Level 3

- All the critical information that is present is correct; may be missing a few pieces of critical information.

Level 4

- All critical information is given and is correct; may be missing subtle details or tone; may have incorrect noncritical information that does not interfere with central meaning.

Level 5

- All critical information is present and correct; response conveys insight into situation through tone and/or subtle details.

Writing

Writing measures skill at writing work-related messages; receiving information from customers, co-workers, or suppliers; and then writing down the information to communicate it to someone else. Each *Writing* level rates the **writing mechanics** (such as sentence structure and grammar) **and writing style** of messages students write to describe an audio message.

Level 0

- An attempt is made at the message, but the message is completely garbled with no recognizable sentence structure.

Level 1

- Message conveyed inadequately; overall lack of proper sentence structure.

Level 2

- Message conveyed inadequately; weak sentence structure; large number of mechanical errors.

Level 3

- Message conveyed clearly; most sentences complete; some mechanical errors.

Level 4

- Message conveyed clearly; all sentences are complete; may have a few minor mechanical errors; may have a choppy style.

Level 5

- Message conveyed clearly; good sentence structure; no mechanical errors; highly appropriate for business setting and situation; smooth, logical style.

Teamwork

Teamwork measures skill in choosing behaviors and/or actions that simultaneously support team interrelationships and lead toward the accomplishment of work tasks. There are four levels of complexity, 3 through 6, with Level 3 being the least complex and Level 6 the most complex. Although Level 3 is the least complex, it still represents a level of teamwork skill well above "no skill at all." The levels build on each other, each incorporating the skills at the preceding levels.

Level 3

- Identify team goals and ways to work with other team members to accomplish those goals.
- Choose actions that support the ideas of other team members to accomplish team goals.
- Recognize that a team is having problems finishing a task and identify the cause of those problems.

Level 4

- Identify the organization of tasks and the time schedule that would help accomplish team goals efficiently and effectively.
- Select approaches that accept direction from other team members in order to accomplish tasks and to build and keep up good team relations.
- Identify behaviors that show appreciation for the personal and professional qualities of other team members and respect for their diversity.

Level 5

- Identify courses of action that give direction to other team members effectively.
- Choose approaches that encourage and support the efforts of other team members to further team relationships and/or task accomplishment.
- Consider the possible effects of alternative behaviors on both team relationships and team accomplishments and select the one that would best help the team meet its goals.

Level 6

- Identify the focus of team activity and select a new focus if that would help the team meet its goals more effectively.
- Select approaches that show the willingness to give and take direction as needed to further team goals (e.g., recognize the organization of team members' tasks that would best serve the larger goals of the team).
- Choose approaches that encourage a team to act as a unit and reach agreement when discussing specific issues.
- Identify actions that would help manage differences of opinion among team members, moving the team toward its goals while valuing and supporting individual diversity.

Academic Competencies

Total List of Academic Competencies

Three products of the Ohio Department of Education, Division of Curriculum, Instruction, and Professional Development, describe the academic skills that should be possessed by each student at the end of each grade level:

- *Model Competency-Based Language Arts Program*
- *Model Competency-Based Mathematics Program*
- *Model Competency-Based Science Program*

The following lists were derived from the academic competencies delineated for Grades 9-12 in these documents. Although the competencies are listed separately by grade level in the original documents, the levels were combined—and in some cases refined—for OCAP purposes, any overlap was eliminated, and a numbering system was imposed for ease of reference.

During the course of the OCAP workshops, each of the representatives from business, industry, labor, and community-based organizations was given a copy of these lists of academic competencies and instructed to circle the competencies that an entry-level employee should possess. The results from each panel were tallied to identify those required academic competencies most crucial to entry level in each specific occupational area. The results for this OCAP are presented on pp. 73-76.

Unit: Communications Skills

Subunit: Reading—Structure

Competencies:

RS1 Exhibit knowledge of language structure
RS2 Recognize that there may be more than one interpretation of reading selections
RS3 Recognize various literary devices (e.g., metaphor, simile, personification, hyperbole, pun, alliteration)
RS4 Recognize and discuss literary elements (e.g., plot, dialogue, theme, setting, characterization)
RS5 Develop and use an increasingly sophisticated vocabulary gained through context
RS6 Apply knowledge of language structure to reading
RS7 Explain why there may be more than one interpretation of reading selections
RS8 Recognize effect of literary devices on meaning
RS9 Analyze author's use of literary elements
RS10 Recognize relationship of structure to meaning
RS11 Describe various interpretations and levels of meaning in reading selections (e.g., symbolism, nuance)
RS12 Characterize author's use of literary devices
RS13 Characterize use of literary techniques (e.g., irony, satire, allegory, onomatopoeia)
RS14 Critique a variety of literature with regard to plot, dialogue, theme, setting, and characterization
RS15 Apply an expanding vocabulary gained through reading
RS16 Explain various interpretations and levels of meaning in reading selections (e.g., symbolism, nuance)
RS17 Analyze use of literary devices (e.g., extended metaphor, simile, personification, hyperbole, pun, alliteration)
RS18 Understand use of literary techniques (e.g., irony, satire, allegory, onomatopoeia)
RS19 Analyze and synthesize pieces of literature with regard to plot, dialogue, theme, setting, and characterization

Subunit: Reading—Meaning Construction

Competencies:

- RM1 Demonstrate ability to recognize appropriate pre-reading strategies
- RM2 Describe effectiveness of a reading selection
- RM3 Read to clarify personal thinking and knowledge
- RM4 Support interpretation of text by locating and citing specific information
- RM5 Develop personal response to a variety of literary works
- RM6 Recognize diverse literary interpretations
- RM7 Engage in self-selected reading activities
- RM8 Confirm and extend meaning in reading by researching new concepts and facts
- RM9 Self-monitor and apply corrective strategies when communication has been interrupted or lost
- RM10 Use features of literary genres to extend meaning
- RM11 Assess effectiveness of a selection read
- RM12 Use reading as a possible problem-solving strategy to clarify personal thinking and knowledge
- RM13 Use knowledge of semantic elements (e.g., figurative language, denotation, connotation, dialect) to clarify meaning when reading
- RM14 Predict, recognize, interpret, and analyze themes based on familiarity with author's work
- RM15 Compare and contrast literary genres
- RM16 Assess validity and quality of selection read (e.g., predict, summarize, analyze, infer)
- RM17 Clarify meaning when reading, using knowledge of literary devices, stylistic diction, and other semantic elements
- RM18 Compare personal reaction to critical assessment of a literary selection
- RM19 Assess validity of diverse literary interpretations
- RM20 Use reference books to find, evaluate, and synthesize information
- RM21 Identify tone of a literary work (e.g., ironic, serious, conversational, humorous)
- RM22 Critique validity of diverse literary interpretations
- RM23 Integrate personal reaction to and critical assessment of a literary selection

Subunit: Reading—Application

Competencies:

- RA1 Select and read material for personal enjoyment and information
- RA2 Read a variety of complete, unabridged works (e.g., self-selected or assigned stories, essays, nonfiction, plays, novels, poetry)
- RA3 Employ various reading strategies (e.g., scanning, skimming, reviewing, questioning, testing, retaining) according to purpose
- RA4 Participate in selection of books, materials, and topics for literature study groups
- RA5 Develop and apply knowledge of the interrelationship of concepts (e.g., construction of webs, graphs, timelines)
- RA6 Read selections from a variety of styles and formats, recognizing that style and format influence meaning
- RA7 Extend value of reading, writing, speaking, viewing, and listening by pursuing, through reading, new concepts and interests developed as a result of these activities
- RA8 Read extensively from the works of a particular author, and explain elements of author's style

Subunit: Reading—Multidisciplinary

Competencies:

- RM1 Connect themes and ideas across disciplines through literature
- RM2 Read to facilitate learning across curriculum
- RM3 Read to develop awareness of human rights and freedom
- RM4 Participate actively in a community of learners

RM5 Recognize and explain interaction between literature and various cultural domains (e.g., social, technological, political, economic)
RM6 Explore and analyze a variety of cultural elements, attitudes, beliefs, and value structures by reading and experiencing our diverse literary tradition, including works by men and women of many racial, ethnic, and cultural groups
RM7 Value thinking and language of others
RM8 Relate literature to historical period about which or in which it was written
RM9 Read to facilitate content learning

Subunit: Writing—Structure

Competencies:

WS1 Develop and expand a repertoire of organizational strategies (e.g., narration, comparison/contrast, and description) through practice and discussion
WS2 Clarify word choice according to audience, topic, and purpose
WS3 Locate and correct errors in usage, spelling, and mechanics (e.g., subject-verb agreement, parallel construction, pronoun reference, punctuation, capitalization, sentence structure) using a variety of resources
WS4 Recognize information gained from primary and secondary sources
WS5 Develop writing that contains ordered, related, well-developed paragraphs with sentences of varied lengths and patterns
WS6 Use information from a variety of sources to develop an integrated piece of writing
WS7 Evaluate and revise writing to focus on such things as audience, tone, and purpose
WS8 Recognize differences between documentation and reference list styles
WS9 Develop extended pieces of writing that contain ordered, related, well-developed paragraphs with sentences of varied lengths and patterns
WS10 Select from a repertoire of organization strategies a pattern appropriate to a topic (e.g., narration, example, detail, comparison/contrast, classification)
WS11 Synthesize information from a variety of sources to construct meaning
WS12 Refine word choice and tone according to audience, situation, and purpose
WS13 Appropriately cite information gained from primary and secondary sources
WS14 Use style manuals or software to prepare documentation and reference lists
WS15 Develop effectively organized pieces of expository writing containing strong voice, clear thesis, and well-developed ideas
WS16 Identify organization patterns appropriate to writing topic
WS17 Respond to others' suggested revisions to a writing piece

Subunit: Writing—Meaning Construction

Competencies:

WM1 Demonstrate knowledge of the recursive nature of the writing process by applying it appropriately to various topics, situations, and audiences (e.g., making connections between prior knowledge and new information, consulting other sources)
WM2 Develop criteria for writing evaluation using scoring guides (e.g., rubric/holistic scale, primary trait scoring) and peer/teacher assistance to clarify meaning
WM3 Respond to others' suggested revisions to a piece of writing (e.g., self-question, re-read, revise)
WM4 Use word processing, graphics, and publishing as aids for constructing meaning in writing
WM5 Engage in self-initiated writing activities
WM6 Incorporate personal criteria with generally accepted standards for writing evaluation
WM7 Evaluate, analyze, and synthesize information for writing
WM8 Evaluate own writing using personal and established scoring criteria
WM9 Assess personal/peer revisions to a writing piece
WM10 Recognize and refine personal writing styles

Subunit: Writing—Application

Competencies:

- WA1 Apply appropriate writing techniques (e.g., prewriting, drafting, revising, editing, presenting) suitable for varied writing tasks
- WA2 Use sentence-combining techniques to improve syntactic fluency and maturity
- WA3 Write in response to prompted and self-selected topics in practical, persuasive, descriptive, narrative, and expository domains
- WA4 Develop personal voice in writing
- WA5 Consider audience and purpose for writing
- WA6 Develop criteria for selection and potential development of topic
- WA7 Write in a journal or learning log to clarify personal thinking and knowledge
- WA8 Apply an expanding vocabulary gained through writing
- WA9 Make judicious use of reference sources (e.g., dictionary, thesaurus, online database, encyclopedia)
- WA10 Demonstrate an appreciation for aesthetically pleasing language through word choice and style
- WA11 Apply revising and editing strategies needed for writing task
- WA12 Vary sentence lengths and patterns
- WA13 Refine personal voice in writing
- WA14 Vary styles and formats for intended purpose and audience
- WA15 Apply criteria for selection and development of topic
- WA16 Participate in peer review of writing in progress
- WA17 Use transitions between sentences, ideas, and paragraphs in writing
- WA18 Revise and edit papers extensively in preparation for presentation/publication
- WA19 Develop a variety of genres (e.g, fantasy, science fiction, short stories, poetry)
- WA20 Focus writing and tone on such elements as audience, situation, and purpose
- WA21 Develop topic fully and appropriately
- WA22 Use writing process to clarify personal thinking and knowledge
- WA23 Apply appropriate recursive writing process as suggested by writing task and writer's process
- WA24 Develop an extended piece of writing (e.g., story, narrative poem, autobiography, novel, research paper)
- WA25 Revise writing and tone to assure focus on such elements as audience, situation, and purpose
- WA26 Use writing process to write reflectively

Subunit: Writing—Multidisciplinary

Competencies:

- WM1 Use writing process for learning across curriculum
- WM2 Use writing process to demonstrate knowledge of need for human rights and freedom
- WM3 Value and apply collaborative skills in the writing process
- WM4 Write in response to reading, speaking, viewing, and listening
- WM5 Use multidisciplinary resources in writing projects
- WM6 Use writing process to facilitate learning across curriculum
- WM7 Recognize value of and engage in collaboration in the writing process
- WM8 Use communication processes to develop a published writing piece in collaboration with others
- WM9 Record experiences and observations related to content learning
- WM10 Apply collaborative skills in the writing process
- WM11 Write collaboratively with peers
- WM12 Use cross-disciplinary resources in writing projects

Subunit: Listening/Visual Literacy—Structure

Competencies:

- LS1 Listen to and view a wide variety of genres (e.g, mystery, drama, poetry)
- LS2 Become aware of an author's style through listening to and viewing a variety of works

LS3 Recognize correct and appropriate grammar, diction, and syntax
LS4 Expand vocabulary through listening to and viewing varied media (e.g., recordings, films, music, news broadcasts)
LS5 Recognize beauty of language
LS6 Enhance recognition of an author's style through listening to and viewing a variety of works
LS7 Recognize use and misuse of language in media
LS8 Refine knowledge of style through listening to and viewing multiple works by the same author
LS9 Expand and refine grammar, diction, and syntax through listening
LS10 Compare authors' styles through viewing and listening to their works
LS11 Expand knowledge of complex grammar, diction, and syntax issues

Subunit: Listening/Visual Literacy—Meaning Construction

Competencies:

LM1 Develop critical thinking skills necessary to evaluate media and assess oral presentations
LM2 Compare new oral texts to past experiences and knowledge in order to enhance comprehension
LM3 Recognize how rhythmic patterns, silence, and cadences enhance quality of speech and literature
LM4 Focus listening and viewing on themes and/or plots
LM5 Gather information from listening and viewing experiences to enhance research
LM6 Use critical thinking skills to evaluate media and oral presentations
LM7 Use prior knowledge and experiences to facilitate comprehension of new oral texts
LM8 Identify rhythmic and time patterns in speech and literature
LM9 Identify and analyze themes and/or plots when listening and viewing
LM10 Use information gathered from listening and viewing experiences to expand research
LM11 Enhance use of critical thinking skills to evaluate media and oral presentations
LM12 Consider prior knowledge and experiences when attempting to understand the meaning of new texts
LM13 Appreciate rhythmic and time patterns of speech and literature
LM14 Select viewing and listening materials to support written text
LM15 Evaluate media and oral presentations analytically and critically
LM16 Organize prior knowledge and experiences to comprehend new texts
LM17 Organize and use viewing and listening materials to support written text

Subunit: Listening/Visual Literacy—Application

Competencies:

LA1 Listen attentively during oral reading
LA2 Use media as stimuli for learning and thinking
LA3 Develop knowledge of structure through art, music, and literature
LA4 Use electronic media to enhance and highlight language learning
LA5 Listen and view for entertainment and enjoyment
LA6 Use technology and other media (e.g., videos, posters, maps, graphs, t-shirts) as means of expressing ideas

Subunit: Listening/Visual Literacy—Multidisciplinary

Competencies:

LM1 Facilitate learning across curriculum through critical listening and viewing
LM2 Engage in individual, small-group, and whole-group listening and viewing activities
LM3 Develop language arts (e.g., viewing, listening) projects collaboratively
LM4 Investigate language and cultural differences through listening and viewing activities
LM5 Participate in a community of learners through productive listening

Subunit: Oral Communication—Structure

Competencies:

- OS1 Refine oral communication skills (e.g., voice modulation, eye contact, body language)
- OS2 Demonstrate knowledge of grammar, usage, and syntax when presenting
- OS3 Select topics and vocabulary suitable to audience
- OS4 Organize notes and ideas for speaking (e.g., cause-effect, chronological, exemplification)
- OS5 Use language imaginatively (e.g., word games, puns, limericks)
- OS6 Modulate voice to enhance meaning when interpreting literature orally
- OS7 Organize notes and ideas for formal, semiformal, and informal presentations of information
- OS8 Refine speaking techniques for formal, semiformal, and informal settings
- OS9 Develop repertoire of organizational strategies for presenting information orally
- OS10 Expand vocabulary to fit topic
- OS11 Select topics suitable to audience, situation, and purpose
- OS12 Select appropriate strategies when organizing notes and ideas for speaking

Subunit: Oral Communications—Meaning Construction

Competencies:

- OM1 Make connections between prior knowledge and new information for oral presentations
- OM2 Participate in informal speaking activities (e.g., offering opinions, supporting statements, questions, clarification, entertainment)
- OM3 Use interviewing techniques to gather information
- OM4 Communicate orally to entertain and to inform
- OM5 Participate in group communication activities (e.g., debates, panel discussions, negotiations, book-sharing, roundtables, cooperative/collaborative groups)
- OM6 Take and organize notes when preparing speech/presentation
- OM7 Interpret texts orally to illustrate meaning
- OM8 Respond to needs of various audiences
- OM9 Gather and assess information for speaking
- OM10 Communicate orally to inform and persuade
- OM11 Prepare and deliver formal speech/presentation
- OM12 Participate in a variety of oral interpretations
- OM13 Assess needs of audience, and adjust language and presentation according to their knowledge
- OM14 Analyze and synthesize information for speaking
- OM15 Describe effectiveness of a literary selection
- OM16 Describe topic or idea in order to clarify personal/audience thinking
- OM17 Analyze and synthesize information gathered from a variety of sources (e.g., interviews, hypermedia, reference works) for speaking
- OM18 Describe validity and/or quality of a literary selection and justify selection
- OM19 Interpret orally a variety of literature
- OM20 Describe topic or idea to clarify meaning for others

Subunit: Oral Communication—Application

Competencies:

- OA1 Become proficient at using interviewing techniques
- OA2 Give an oral interpretation for a specific audience
- OA3 Develop and apply oral communication skills for cooperative/collaborative learning
- OA4 Use oral communication for a variety of purposes and audiences (e.g., negotiations, book reviews, rationales)
- OA5 Develop and apply decision-making strategies
- OA6 Practice interviewing techniques
- OA7 Apply interviewing techniques to purposeful interviews
- OA8 Focus oral interpretation on a specific audience

Subunit: Oral Communications—Multidisciplinary

Competencies:

- OM1 Value thinking and language of others
- OM2 Develop oral projects collaboratively
- OM3 Be involved in individual, small-group, and whole-group language activities
- OM4 Participate actively in a community of learners
- OM5 Investigate language and cultural differences through oral language activities

Unit: Mathematics Skills

Subunit: Numbers and Number Relations

Competencies:

- NR1 Compare, order, and determine equivalence of real numbers
- NR2 Estimate answers, compute, and solve problems involving real numbers
- NR3 Compare and contrast real number system, rational number system, and whole number system
- NR4 Extend knowledge to complex number system, and develop facility with its operation

Subunit: Measurement

Competencies:

- M1 Estimate and use measurements
- M2 Understand the need for measurement and the probability that any measurement is accurate to some designated specification
- M3 Understand and apply measurements related to power and work
- M4 Understand and apply measurement concepts of distance-rate-time problems and acceleration problems with real-world experiments
- M5 Use real experiments to investigate elasticity, heat, sound, electricity, magnetism, light, acceleration, velocity, energy, and gravity
- M6 Use real-world problem situations involving mass and weight
- M7 Use real-world problem situations involving simple harmonic motion
- M8 Establish ratios with and without common units
- M9 Construct and interpret maps, tables, charts, and graphs as they relate to real-world mathematics
- M10 Understand and solve rate-change problems
- M11 Understand and solve right triangle relationships as they relate to measurement—specifically those that deal with the Pythagorean theorem
- M12 Graph and interpret ordered pairs
- M13 Compute total sales from a variety of items
- M14 Comprehend and compute rates of growth or decay
- M15 Comprehend, compute, and interpret real problems involving annuities
- M16 Develop an ability to identify real problems and provide possible solutions
- M17 Express and apply different types of measurement scales
- M18 Determine area and volume

NOTE: The math subunit on problem solving was not included on this list since it should be a continuing thread throughout all instruction rather than a separate set of competencies.

Subunit: Estimation and Mental Computation

Competencies:

- E1 Use estimation to eliminate choices in multiple-choice tests
- E2 Use estimation to determine reasonableness of problem situations in a wide variety of applications
- E3 Estimate shape of graphs of various functions and algebraic expressions
- E4 Use mental computation when computer and calculator are inappropriate

Subunit: Data Analysis and Probability

Competencies:

- D1 Organize data into tables, charts, and graphs
- D2 Understand and apply measures of central tendency, variability, and correlation
- D3 Use curve fitting to predict from data
- D4 Use experimental or theoretical probability, as appropriate, to represent and solve problems involving uncertainty
- D5 Use computer simulations and random number generators to estimate probabilities
- D6 Test hypotheses using appropriate statistics
- D7 Read, interpret, and use tables, charts, and graphs to identify patterns, note trends, draw conclusions, and make predictions
- D8 Identify probabilities of events involving unbiased objects
- D9 Use sampling and recognize its role in statistical claims
- D10 Design a statistical experiment to study problem, conduct experiment, and interpret and communicate outcomes
- D11 Describe normal curve in general terms, and use its properties
- D12 Create and interpret discrete probability distributions
- D13 Understand concept of random variable
- D14 Apply concept of random variable to generate and interpret probability distributions, including binomial, uniform, normal, and chi square.

Subunit: Algebra

Competencies:

- A1 Describe problem situations by using and relating numerical, symbolic, and graphical representations
- A2 Use language and notation of functions in symbolic and graphing settings
- A3 Recognize, relate, and use the equivalent ideas of zeros of a function, roots of an equation, and solution of an equation in terms of graphical and symbolic representations
- A4 Describe and use logic of equivalence in working with equations, inequalities, and functions
- A5 Develop graphical techniques of solution for problem situations involving functions
- A6 Explore and describe characterizing features of functions
- A7 Make arguments and proofs in algebraic settings
- A8 Factor difference of two squares
- A9 Determine slope, midpoint, and distance
- A10 Explore and combine rational functions
- A11 Explore factoring techniques
- A12 Solve quadratic equations by factoring and formula
- A13 Set up and solve linear equations
- A14 Solve systems of linear equations with two variables
- A15 Describe geometric situations and phenomena using variables, equations, and functions
- A16 Describe measures of central tendency, mean, median, mode, and variance algebraically and graphically
- A17 Represent inequalities on the number line and in the coordinate plane
- A18 Use coordinate arguments in making geometric proofs

A19 Symbolize transformations of figures and graphs
A20 Explore geometric basis for functions of trigonometry
A21 Graph linear functions
A22 Develop and use vectors to represent direction and magnitude, including operations
A23 Use polar and parametric equations to describe, graph, and solve problem situations
A24 Represent sequences and series as functions both algebraically and graphically
A25 Explore recursive functions and procedures using spreadsheets, other computer utilities, and notions appropriate to these problem situations
A26 Describe and solve algebraic situations with matrices
A27 Describe and use inverse relationship between functions, including exponential and logarithmic
A28 Analyze and describe errors (and their sources) that can be made when using computers and calculators to solve problems
A29 Decide whether problem situation is best solved using computer, calculator, paper and pencil, or mental arithmetic/estimation techniques
A30 Explore relationships between complex numbers and vectors
A31 Make arguments concerning limits; convergence and divergence in contexts involving sequences, series, and other types of functions
A32 Represent transformations in the plane with matrices
A33 Contrast and compare algebras of rational, real, and complex numbers with characteristics of a matrix algebra system
A34 Construct polynomial approximations of a function over specified intervals of convergence
A35 Examine complex numbers as zeros of functions
A36 Translate verbal statements into symbolic language
A37 Simplify algebraic expressions
A38 Use laws and exponents (including scientific notation)
A39 Expand and extend idea of vectors and linear algebra to higher dimensional situations
A40 Use the idea of independent basis elements for a vector space and associated fundamental concepts of finite dimensional linear algebra
A41 Develop and communicate arguments about limit situations
A42 Use matrices to describe and apply transformations
A43 Develop and use polar and parametric equations to represent problem situations
A44 Explore proofs by mathematical induction

Subunit: Geometry

Competencies:

G1 Create and interpret drawings of three-dimensional objects
G2 Represent problem situations with geometric models and apply properties of figures
G3 Apply Pythagorean theorem
G4 Demonstrate knowledge of angles and parallel and perpendicular lines
G5 Explore inductive and deductive reasoning through applications to various subject areas
G6 Translate between synthetic and coordinate representations
G7 Identify congruent and similar figures using transformation with computer programs
G8 Deduce properties of figures using transformations and coordinates
G9 Use deductive reasoning
G10 Explore compass and straightedge constructions in context of geometric theorems
G11 Demonstrate knowledge of and ability to use proof
G12 Use variety of proof techniques (e.g., synthetic, transformational, and coordinate)
G13 Use variety of proof formats, including T-proof (i.e., two-column) and paragraph proof
G14 Explore different proof strategies
G15 Investigate different proofs of theorems
G16 Develop knowledge of an axiomatic system
G17 Apply transformations and coordinates in problem solving
G18 Represent problem situations with geometric models, and apply properties of figures

G19 Deduce properties of figures using vectors
G20 Analyze properties of Euclidean transformations, and relate translations to vectors
G21 Apply vectors in problem solving
G22 Develop further knowledge of axiomatic systems by investigating and comparing various geometries

Subunit: Patterns, Relations, and Functions

Competencies:

P1 Model real-world phenomena with polynomial and exponential functions
P2 Explore relationship between zeros and intercepts of functions
P3 Translate among tables, algebraic expressions, and graphs of functions
P4 Use graphing calculator or computer to generate graph of a function
P5 Explore relationship between a linear function and its inverse
P6 Describe and use characteristics of polynomial functions in problem-solving situations
P7 Explore conic sections, and graph using graphing calculator or computer
P8 Apply trigonometric functions to problem situations involving triangles
P9 Discover general relationships between algebraic description of conic, kind of conic, and special properties of that conic
P10 Explore periodic real-world phenomena using sine and cosine functions
P11 Analyze effects of parameter changes on graphs
P12 Use graphing calculator or computer to graph functions
P13 Develop a knowledge of rational and transcendental functions
P14 Understand connections between trigonometric and circular functions
P15 Use circular functions to model periodic real-world functions
P16 Solve trigonometric equations, and verify trigonometric identities
P17 Understand connections between trigonometric functions and polar coordinates, exponential functions, logarithmic functions, complex numbers, and series
P18 Model real-world phenomena with a variety of functions
P19 Graph using polar coordinates
P20 Explore graphs in three dimensions
P21 Explore functions of several variables
P22 Explore recursive functions using spreadsheets and/or programming languages

Unit: Science Skills

Subunit: Scientific Inquiry

Competencies:

Q1 Check the appropriateness and accuracy of measures and computations using various strategies (e.g., estimations, unit analysis, determination of significant figures)
Q2 Use ratios, proportions, and probabilities in appropriate problem situations
Q3 Translate information from and represent information in various forms with equal ease (e.g., tables, charts, graphs, diagrams, geometric figures)
Q4 Use existing algebraic formulas and create new ones in appropriate problem-solving situations
Q5 Estimate and justify probabilities of outcomes of familiar situations based on experimentation and other strategies
Q6 Invent apparatus and mechanical tools needed to perform unique tasks in various situations
Q7 Identify, compare, and contrast different modes of inquiry, habits of mind, and attitudes and dispositions
Q8 Design investigations that are safe and ethical (i.e., obtain consent and inform others of potential outcomes, risks, and benefits; and show evidence of concern for the health and safety of humans and non-human species)

Q9 Make and read scale drawings, maps, models, and other representations to aid planning and understanding
Q10 Seek elaboration and justification of data and ideas, and reflect on alternative interpretations of the information
Q11 Use appropriate units for counts and measures
Q12 Create and use databases (electronic and other) to collect, organize, and verify data and observations
Q13 Design and conduct investigations with multiple variables
Q14 Communicate the results of investigations clearly in a variety of situations
Q15 Examine relationships in nature, offer alternative explanations for the observations, and collect evidence that can be used to help judge among explanations
Q16 Trace the development (e.g., history, controversy, and ramifications) of various theories, focusing on supporting evidence and modification with new evidence
Q17 Select, invent, and use tools, including analog and digital instruments, to make and record direct measurements
Q18 Observe and document events and characteristics of complex systems
Q19 Explain the influence of perspective (e.g., spatial, temporal, and social) on observation and subsequent interpretations
Q20 Create multiple representations of the same data using a variety of symbols, descriptive languages, mathematical concepts, and graphic techniques
Q21 Generate testable hypotheses for observations of complex systems and interactions
Q22 Document potentially hazardous conditions and associated risks in selected homes and public areas
Q23 Participate in public debates, relying on documented and verified data to construct and represent a position on scientific issues
Q24 Construct and test models of physical, biological, social, and geological systems
Q25 Read, verify, debate, and, where necessary, refute research published in popular or technical journals of science (e.g., *Discover, Omni, Popular Mechanics*)
Q26 Explore discrepant events and develop and test explanations of what was observed
Q27 Conduct theory-based research using surveys, observational instruments, and other methods
Q28 Modify personal opinions, interpretations, explanations, and conclusions based on new information
Q29 Analyze error and develop explanations in various domains
Q30 Formulate taxonomic schemes based upon multivariate models that help to explain similarities and differences in form, distribution, behavior, survival, and origin of objects and organisms
Q31 Demonstrate various logical connections between related concepts (e.g., entropy, conservation of energy)
Q32 Account for discrepancies between theories and observations
Q33 Analyze the changes within a system when inputs, outputs, and interactions are altered
Q34 Create, standardize, and document procedures
Q35 Determine the sources of significant disparities between the predicted and recorded results, and change research procedures to minimize disparities
Q36 Research, locate, and propose applications for abstract patterns (e.g., fractals, Fibonacci sequences, string theory, orbitals)
Q37 Recognize and utilize classification systems for particles, elements, compounds, phenomena, organisms, and others for exploring and predicting properties and behaviors
Q38 Suggest and defend alternative experimental designs and data explanations (e.g., sampling, controls, safeguards)
Q39 Recognize and communicate differences between questions that can be investigated in a scientific way and those that rely on other ways of knowing
Q40 Draw conclusions based on the relationships among data analysis, experimental design, and possible models and theories
Q41 Suggest new questions as a result of reflection on and discussions about own scientific investigations
Q42 Investigate, assess, and comment on strengths and weakness of the descriptive and predictive powers of science
Q43 Create new information from representations of data in a variety of forms (e.g., symbols, descriptive languages, graphic formats) utilizing a variety of techniques (e.g., interpolations, extrapolations, linear regressions, central tendencies, correlations)

Subunit: Scientific Knowledge

Competencies:

- K1 Investigate various types of dynamic equilibrium (e.g., biological, geological, mechanical, chemical)
- K2 Investigate the relationship between the rates of energy exchange and the relative energy level of components within systems (e.g., trophic levels of ecosystems, osmosis, rate of heating and cooling, storms)
- K3 Investigate patterns in the natural world (e.g., heredity, crystalline structures, population and resource distributions, diffraction, dispersion, polarization)
- K4 Investigate models and theories that help to explain the interactions of components in systems (e.g., conservation of mass, energy, and momentum; foodwebs; natural selection; entropy; plate tectonics; chaos; relativity; social-psychology)
- K5 Investigate degrees of kinship among organisms and groups of organisms
- K6 Investigate the limits of the definition of life, and investigate organisms and physical systems that exist at or near these limits (e.g. viruses, quarks, black holes)
- K7 Investigate estimates and measurements of a wide range of distances and rates of change
- K8 Investigate the historical development of theories of change over time (e.g., natural selection, continental drift, the big bang, geologic change)
- K9 Investigate physical and chemical changes in living and nonliving systems (e.g., photosynthesis, weathering processes, glaciation, thermal effects of materials, energy cells)
- K10 Investigate simulations of nuclear change (e.g., radioactivity, half life, carbon dating)
- K11 Investigate conservation principles associated with physical, chemical, and nuclear changes
- K12 Formulate descriptions of the impacts of various forms of mechanical and electromagnetic waves on various organisms and objects
- K13 Formulate models and hypotheses for patterns in the natural world (e.g., earth structures, transportation systems, migrations, communications, constellations)
- K14 Formulate explanations for the influences of objects and organisms on each other over time
- K15 Formulate and interpret explanations for change phenomena (e.g., mass extinctions, stellar evolution, punctuated equilibrium, molecular synthesis)
- K16 Formulate and interpret explanations for the magnitudes of diversity at different periods of geologic time (e.g., mutation, global cataclysms, continental drift, competition, mass extinctions)
- K17 Formulate interpretations of the structure, function, and diversity in a variety of organisms and physical systems (e.g., DNA and RNA variants, nucleons, interaction particles)
- K18 Formulate understandings of geologic time (e.g., millennia, periods, epochs)
- K19 Formulate an understanding of the historical development of the model of the universe (e.g., Aristotle, Ptolemy, Copernicus, Brahe, Kepler, Galileo, Newton, Einstein)
- K20 Formulate explanations and representations of the production, transmission, and conservation of energy in biological and physical systems (e.g., weather, volcanism, earthquakes, electricity, magnetism, cellular respiration)
- K21 Formulate models and hypotheses about patterns in the natural world (e.g., social behavior, molecular structure, energy transformation, entropy, randomness, aging, chaos, hormonal cycles)
- K22 Formulate interpretations of the relationship between energy exchange and the interfaces between components within systems
- K23a Formulate estimations for the range of energies within and between various phenomena (e.g., thermal, electromagnetic, thermonuclear, chemical, electrical)
- K23b Formulate explanations for the historical development of descriptions of motions interactions and transformations of matter and energy (e.g., classical Newtonian mechanics, special and general relativity, chaos)
- K24 Formulate models that can be used to describe fundamental molecular interactions in living and non-living systems (e.g., cell membranes, semiconductors).
- K25 Formulate an understanding of the degree of relationship among organisms and objects based on molecular structure (e.g., proteins, nucleic acids)
- K26 Formulate hypotheses and models that may account for observable events (e.g., electricity and magnetism, gravitation, atoms, bonding, chemical reactions, quantum effects, energy flow on biological systems, predator-prey relationships)

K27 Formulate models and hypotheses about change over time (e.g., natural selection, speciation, punctuated equilibrium, phyleytic gradualism, stellar evolution, plate tectonics, radioactive decay, quantum mechanical theory)

K28 Formulate lists of limitations, and propose refinements of standard classification systems (e.g., periodic table, IUPAC, Linnean, standard model)

K29 Formulate specific cases of limitations and possible exceptions of theories and principles regarding the interactions of moving objects and organisms (e.g., fluid flow in vessels, motion near the speed of light, Heisenberg uncertainty principle, meteorological prediction, local variation and diversity, earthquake prediction, energy transport in cellular respiration)

K30 Formulate plans and contingencies that can be used to accommodate for changes to and stresses on systems (e.g., wildlife and habitat management, corrosion prevention, noise abatement, structure design)

K31 Formulate models of molecular, atomic, ionic, and subatomic structures and the physical and biological implications of these structures (e.g., genes, nucleons, quarks)

K32 Formulate estimates for a wide range of measurements and scales (e.g., angstroms to light years)

K33 Formulate and interpret representations of time from origin to present accounting for phenomena of scale (e.g., smoothness, punctuations, chaos)

K34 Formulate interpretations of the historical development of various theories of possible causes of diversity among physical and biological phenomena (e.g., the works of Aristotle, Mendel, Darwin, McClintock)

K35 Formulate models and hypotheses that can be used to explain the interactions of components within technological and ecological systems

Subunit: Conditions for Learning Science

Competencies:

C1 Participate actively in dialogue about and resolution of community issues

C2 Assess information from various countries in the original language or translated form to ascertain the perspectives of many cultures

C3 Analyze the scientific ideas presented in science fiction stories and films

C4 Perform and repeat investigations to verify data, determine regularity, and reduce the impact of experimental error

C5 Present the results of investigations in a variety of forums

C6 Contribute to the decisions regarding topics for investigation

C7 Use various creative means to communicate interpretations of scientific ideas, concepts, phenomena, and events

C8 Consider the scientific thinking and language of others

C9 Individually and collaboratively produce clearly written representations of investigative results

C10 Fulfill responsibilities as part of a research group

C11 Select and utilize resources by various criteria (e.g., efficiency, effectiveness, health, safety) that are appropriate to the investigations being conducted by groups

C12 Present persuasive argument based on the scientific aspects of controversial issues

C13 Collect, store, retrieve, and manipulate information with available technologies that may range from hand processes up through computer applications

C14 Investigate social issues with a scientific perspective (e.g., human rights, wellness, economics, futurism, environmental ethics)

C15 Keep journals of observations and inferences made over an extended period of time, and reflect upon the impact of these recorded ideas on own thinking and actions

C16 Examine the intellect, perspectives, and ethics of notable scientists

C17 Collect and analyze observations made over extended periods of time and compare these to scientific theories

C18 Create presentations of scientific understandings using diverse modes of expressions

C19 Conduct formal scientific debates in the classroom

C20 Wonder about the likelihood of events that may occur by chance or coincidence
C21 Plan and conduct field trips and experiences for small and large groups
C22 Analyze the historical context that leads to and has led to scientific theories
C23 Seek information on topics of personal scientific interest from a variety of sources
C24 Conduct learner-developed investigations independently and collaboratively over periods of weeks and months
C25 Listen attentively and critically to presentations of scientific information made by others
C26 Conduct analyses of propaganda related to scientific issues
C27 Perform investigations that require observations over varying periods of time
C28 Experience scientific concepts as interpreted by other cultures through multimedia and local and global specialists
C29 Access appropriate technology to perform complicated, time-consuming tasks
C30 Relate historical accounts of science to the cultural context in which they were written
C31 Work as a contributing member of a collaborative research group
C32 Examine the influences of social and political structures and realities that contribute to inquiry about scientific issues
C33 Use technology (e.g., desktop publishing, teleconferencing, networking) to communicate scientific ideas
C34 Explore and analyze a variety of perspectives on science (e.g., works by men and women of many racial, ethnic, and cultural groups)
C35 Lead groups of learners of various ages in designing, planning, and conducting science activities
C36 Respect the scientific thinking of others and self
C37 Recognize and contrast different epistemologies
C38 Develop possible courses of action in response to scientific issues of local and global concern
C39 Determine the validity of research conclusions in relation to the design, performance, and results
C40 Develop multimedia presentations of group and individual research projects and investigations appropriate for a variety of audiences and forums
C41 Produce interesting and scientifically correct stories and present them using various modes of expression
C42 Reflect on the ideas and content found in own journal records
C43 Examine ambiguous results and formulate explanations
C44 Recognize and synthesize the contributions to scientific thought of individuals from many cultures
C45 Construct models and simulations of the component structures and functions of living and nonliving entities
C46 Lead multi-age groups in the examination of and planned resolution for scientific issues
C47 Recognize and choose members of research teams based upon the merit of their ideas and skills
C48 Construct a portfolio of products, documentation, and self-evaluations of own abilities, skills, and experiences
C49 Synthesize scientific information from a variety of sources
C50 Evaluate and prioritize scientific issues based upon risk-benefit analyses
C51 Refine scientific skills from a variety of experiences

Subunit: Applications for Science Learning

Competencies:

A1 Answer student-determined questions by designing databases and drawing inferences from the analyses of the information in these databases
A2 Make personal behavior decisions by interpreting information that has a scientific basis
A3 Propose courses of action that will validate and demonstrate personal understandings of scientific principles
A4 Guide other learners in their understanding of the interactions of technologies and society at various periods in time
A5 Promote and carry out practices that contribute to a sustainable environment

A6 Study and propose improvements in public services and systems in own community
A7 Choose consumer materials utilizing personal and environmental risk and benefit information
A8 Make inferences and draw conclusions using databases, spreadsheets, and other technologies
A9 Do simple troubleshooting on common electrical and mechanical systems, identifying and eliminating possible causes of malfunctions
A10 Construct devices that perform simple, repetitive actions
A11 Investigate the functionality of various geometric shapes in the natural world and the designed world (e.g., translations from spherical to plane representations cause distortions; triangular shapes contribute to rigidity and stability in structures; round shapes minimize boundary for a given capacity)
A12 Make decisions regarding personal and public health
A13 Evaluate the social and ecological risks and benefits resulting from the use of various consumer products
A14 Analyze the contributions of advances in technology through history to own everyday life
A15 Identify and reduce risks and threats to a sustainable environment
A16 Extend the limits of human capabilities using technological enhancements
A17 Use and recognize various propaganda techniques
A18 Solve unique problems using the results of systematic analyses
A19 Choose everyday consumer products that utilize recent innovation and pass appropriate performance criteria
A20 Refine personal career interests through investigations of the diversity of manufacturing, research, service, and invention processes
A21 Predict and investigate the working of toys and tools while controlling and manipulating variables (e.g., friction, gravity, forces)
A22 Write, follow, modify, and extend instructions (e.g., equations, algorithms, formulas, flow diagrams, illustrations)
A23 Create products, make inferences, and draw conclusions using databases, spreadsheets, and other technologies
A24 Predict various scenarios and propose solutions to community issues using scientific information (e.g., actuarial tables, census data, topographic maps, incidence data, climatic data)
A25 Use scientific evidence to consider options and formulate positions about the health and safety of others and self
A26 Search for, use, create, and store objects and information using various strategies and methods of organization and access
A27 Research and write environmental impact statements of own design
A28 Compare school-based science perspectives with those gained through cutting-edge technological applications
A29 Design management plans for natural and human-altered environments (e.g., woodlots, patios, lots, lawns, farmlands, forests)
A30 Refine personal career interests
A31 Promote public awareness of the interaction of technology with social issues
A32 Advocate and propose courses of action for local and global scientific issues using global networks
A33 Use appropriate technologies to prepare and present the findings of investigations incorporating tables, graphs, diagrams, and text
A34 Make informed consumer choices by evaluating and prioritizing information, evidence, and strategies
A35 Develop an informed point of view that allows for validation or refutation of the scientific statements and claims of advocates before pursuing courses of action (e.g., contributing support, signing petitions, casting votes)
A36 Differentiate between observations and inferences in the exploration of evidence related to personal, scientific, and community issues
A37 Develop and write environmental impact, and safety and hygiene management plans
A38 Use technology to collect, analyze, and communicate information (e.g., electronic networks, desktop publishing, remote sensing, graphing calculators, satellite telemetry, and others)
A39 Design, construct, and market inventions

Academic Competencies: Automotive Technician

The Automotive Technician OCAP panel of expert workers (see member list on the inside back cover) identified the following academic competencies (from the total list, pp. 58-72) as most crucial to the success of an entry-level automotive technician. It is recommended that these competencies be taught in an applied manner for students enrolled in automotive technician programs.

Unit: Communications Skills

Subunit: Reading—Structure

Competencies:

RS1	Exhibit knowledge of language structure
RS2	Recognize that there may be more than one interpretation of reading selections
RS6	Apply knowledge of language structure to reading
RS15	Apply an expanding vocabulary gained through reading

Subunit: Reading—Meaning Construction

Competencies:

RM3	Read to clarify personal thinking and knowledge
RM8	Confirm and extend meaning in reading by researching new concepts and facts
RM12	Use reading as a possible problem-solving strategy to clarify personal thinking and knowledge
RM20	Use reference books to find, evaluate, and synthesize information

Subunit: Reading—Application

Competencies:

RA1	Select and read material for personal enjoyment and information
RA7	Extend value of reading, writing, speaking, viewing, and listening by pursuing, through reading, new concepts and interests developed as a result of these activities

Subunit: Reading—Multidisciplinary

Competencies:

RM2	Read to facilitate learning across curriculum
RM7	Value thinking and language of others
RM9	Read to facilitate content learning

Subunit: Writing—Structure

Competencies:

WS2	Clarify word choice according to audience, topic, and purpose
WS4	Recognize information gained from primary and secondary sources

Subunit: Writing—Application

Competencies:

WA1	Apply appropriate writing techniques (e.g., prewriting, drafting, revising, editing, presenting) suitable for varied writing tasks

Subunit: Listening/Visual Literacy—Application

Competencies:

LA1	Listen attentively during oral reading
LA2	Use media as stimuli for learning and thinking

Subunit: Oral Communication—Structure

Competencies:

OS1	Refine oral communication skills (e.g., voice modulation, eye contact, body language)

Subunit: Oral Communications—Meaning Construction

Competencies:

OM3	Use interviewing techniques to gather information

Subunit: Oral Communication—Application

Competencies:

OA6	Practice interviewing techniques

Subunit: Oral Communications—Multidisciplinary

Competencies:

OM1	Value thinking and language of others

Unit: Mathematics Skills

Subunit: Numbers and Number Relations

Competencies:

NR1	Compare, order, and determine equivalence of real numbers
NR2	Estimate answers, compute, and solve problems involving real numbers

Subunit: Measurement

Competencies:

M1	Estimate and use measurements
M2	Understand the need for measurement and the probability that any measurement is accurate to some designated specification
M3	Understand and apply measurements related to power and work
M4	Understand and apply measurement concepts of distance-rate-time problems and acceleration problems with real-world experiments
M5	Use real experiments to investigate elasticity, heat, sound, electricity, magnetism, light, acceleration, velocity, energy, and gravity
M6	Use real-world problem situations involving mass and weight
M7	Use real-world problem situations involving simple harmonic motion
M16	Develop an ability to identify real problems and provide possible solutions
M18	Determine area and volume

Subunit: Estimation and Mental Computation

Competencies:

E2	Use estimation to determine reasonableness of problem situations in a wide variety of applications
E4	Use mental computation when computer and calculator are inappropriate

Subunit: Data Analysis and Probability

Competencies:

D1	Organize data into tables, charts, and graphs
D7	Read, interpret, and use tables, charts, and graphs to identify patterns, note trends, draw conclusions, and make predictions

Subunit: Algebra

Competencies:

A29	Decide whether problem situation is best solved using computer, calculator, paper and pencil, or mental arithmetic/estimation techniques

Unit: Science Skills

Subunit: Scientific Inquiry

Competencies:

Q1	Check the appropriateness and accuracy of measures and computations using various strategies (e.g., estimations, unit analysis, determination of significant figures)
Q2	Use ratios, proportions, and probabilities in appropriate problem situations
Q3	Translate information from and represent information in various forms with equal ease (e.g., tables, charts, graphs, diagrams, geometric figures)
Q11	Use appropriate units for counts and measures
Q12	Create and use databases (electronic and other) to collect, organize, and verify data and observations
Q14	Communicate the results of investigations clearly in a variety of situations
Q17	Select, invent, and use tools, including analog and digital instruments, to make and record direct measurements
Q18	Observe and document events and characteristics of complex systems
Q28	Modify personal opinions, interpretations, explanations, and conclusions based on new information
Q32	Account for discrepancies between theories and observations
Q33	Analyze the changes within a system when inputs, outputs, and interactions are altered
Q34	Create, standardize, and document procedures

Subunit: Scientific Knowledge

Competencies:

K22	Formulate interpretations of the relationship between energy exchange and the interfaces between components within systems

Subunit: Conditions for Learning Science

Competencies:

C13	Collect, store, retrieve, and manipulate information with available technologies that may range from hand processes up through computer applications

Subunit: Applications for Science Learning

Competencies:

A8	Make inferences and draw conclusions using databases, spreadsheets, and other technologies
A9	Do simple troubleshooting on common electrical and mechanical systems, identifying and eliminating possible causes of malfunctions
A12	Make decisions regarding personal and public health
A13	Evaluate the social and ecological risks and benefits resulting from the use of various consumer products
A18	Solve unique problems using the results of systematic analyses
A21	Predict and investigate the working of toys and tools while controlling and manipulating variables (e.g., friction, gravity, forces)

Verification Panels

The Vocational Instructional Materials Laboratory wishes to extend thanks and appreciation to the many representatives of business, industry, labor, and community organizations who donated their time and expertise to the identification and revalidation of competencies.

The following panel was responsible for verifying the occupational competencies on the Automotive Technician OCAP, identifying those academic competencies that an entry-level employee should possess, and determining the Work Keys academic skill levels required for successful entry into the occupation:

Jeff Bach, *C.R.T. Auto Electronics,* Batavia, Ohio
David Christopher, *Christopher's Car Care Inc.*, Tallmadge, Ohio
Earl R. Dohner, *E & E's Garage,* Brookville, Ohio
James R. Gorsuch, *Liberty Dealerships*, Johnstown, Ohio
Richard Miller, *Crown Chrysler-Plymouth-Jeep-Eagle*, Dublin, Ohio
Michael N. Smith, *Krieger Ford*, Columbus, Ohio
Joseph Szpila, *Taylor Buick Inc.*, Toledo, Ohio
Joseph L. Weber, *Weber & Son Service & Repair Inc.*, Strongsville, Ohio

The following panel was responsible for verifying the competencies on the Employability OCAP:

Barbara J. Forster, *Nationwide Insurance,* Columbus, Ohio
Joan L. Hall, *Health Management Nursing*, Chesapeake, Ohio
Jane Highland, *Southern Ohio Staffing, Inc.*, Chillicothe, Ohio
Chuck Jackson, *Butech, Inc.*, Salem, Ohio
Garry Kessel, *Medina Auto Parts, Inc.*, Medina, Ohio
Joyce A. McMickens, *Ernst & Young,* Cleveland, Ohio
Julie C. Payeff, *The Andersons Management Corp.*, Maumee, Ohio
Patricia Piper, *Edison Industrial Systems Center,* Toledo, Ohio
Gary F. Rybak, *Red Roof Inns, Inc.*, Hilliard, Ohio